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APPLICATION OF DE VRIES'S MUTATION THEORY TO THE MOLLUSCA

FRANK COLLINS BAKER

PROBABLY no work since the publication of Darwin's *Origin of Species* has produced such a profound sensation in the biological world as the work entitled *Die Mutationstheorie*, by Hugo de Vries. A perusal of that work (or, perhaps better for those not having the time, the shorter work *Species and Varieties; their Origin by Mutation*) leads the zoölogist to ponder upon the question as to how far these theories may be used in connection with animal forms, especially with the invertebrates. Much experimentation, covering a long period of time, must be done, however, before anything definite can be accomplished. De Vries spent twenty years raising and studying primroses. The zoölogist must do likewise and study some common forms for a long period, breeding them under conditions conforming as closely as possible to the natural environments of the organisms. The question of elementary species and varieties is one which would seem to have a meaning in botany somewhat different from the use of the same terms in zoölogy, in fact, in some of the Invertebrata (the Mollusca, for example) there would seem to be no distinction between an elementary species and a variety, the terms being synonymous. However this may be, it would seem that to the Mollusca the de Vries theory might be applied with some interesting results. The writer would ask the question: Are not many of the variations of the Mollusca produced in the manner outlined by this new aspect of evolution? The writer does not feel warranted

in answering this question in the affirmative, but he does believe that the illustrations which follow are suggestive and certainly point to some such derivation. It is not held, even by de Vries, I take it, that the mutation theory is to supplant or take the place of the older evolution by whose slow and gradual processes (natural selection, survival, environment, distribution, etc.) the present state of animal and vegetal matter has been reached, but as an additional process in that great scheme of life.

In certain mollusks the species seem to be unstable, that is, they have a tendency to vary, not in a given direction but in many

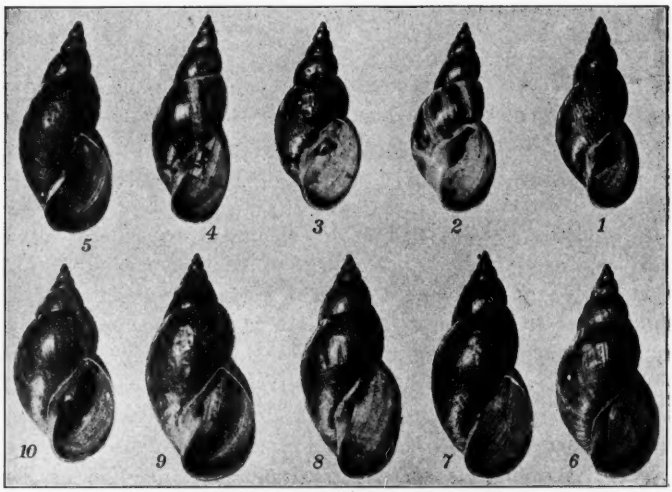


FIG. 1.— *Lymnæa palustris* Müller, from Halma, Minnesota. Note the wide range of variation in the form of the shell. Enlarged.

directions at the same time. These seem to come under the head of mutants, or sports. The fresh-water pulmonates belonging to the genus Lymnæa are examples of this class and every species which has been studied in any quantity has been found to vary in this manner. *Lymnæa palustris* Müller (= *elodes* Say) is one of the most notably variable, and its mutations are many and marked. Fig. 1 represents a set of ten shells of this species collected by Mr. L. E. Daniels in Muskag swamps, Halma, Minnesota. They vary from a long, narrow shell, with elevated spire

(1) to a fat, robust shell, with a comparatively short spire (10). In some specimens the whorls are flat-sided (4), while in others they are convex, especially the last, which is very convex (3, 10). The columella plait also varies in size and elevation and the sutures vary in the degree of impression (compare 3, 4). Several of these mutations, if we can so designate these variations, have

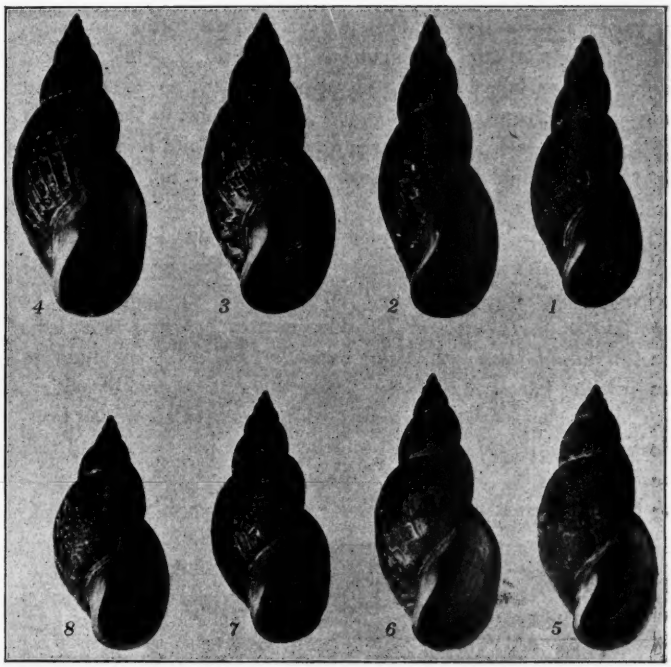


FIG. 2.— *Lymnæa palustris* Müller, from Sugar Island, Alpena, Michigan. Enlarged.

been described as species or varieties; thus 10 is Lea's *nuttalliana* and 1 is Say's *elodes*. It will be seen that no line can be drawn between 1 and 10 in the presence of the intervening figures. Take away these connecting links and a very distinct variety remains.

In the Mollusca the factor of geographic variation plays a very important part. The shells from the locality illustrated in Fig. 1 are rather small, measuring 23 mm. in length. Fig. 2 illustrates the same species from Sugar Island, near Alpena, Michigan (col-

lected by Dr. W. A. Nason); the shells are much larger than those of Fig. 1, and measure 30 mm. in length. It will also be noted that the variation in this lot of shells is not so marked as in those illustrated in Fig. 1. There is considerable difference between the extremes but the majority of specimens conform more or less to a single type, the large, corpulent form. A study of several hundred specimens from each locality shows that each lot varies a certain percentage toward a given form. In lot 1, (Fig. 1), the variation is 75 percent toward no. 1, while in lot 2 (Fig. 2) the variation is about 60 percent toward no. 8. Without more data to disprove it, this would seem to point to the fact that the species of each locality varies toward a definite form. In lot no. 1 the dominant form is *palustris*, while in lot no. 2 the dominant form is *nuttalliana*.

The interesting fact in connection with all this is (and this is where de Vries's mutation theory seems applicable) that all the forms illustrated will develop from the same egg capsule. The eggs laid by *nuttalliana* will produce narrow *palustris* as well as the fat parent form, while the narrowest *palustris* will likewise produce the fattest *nuttalliana*. May this not be an illustration, also, of two types (although this subject is treated under eversporting varieties by de Vries) which he calls poor races and rich races. In Fig. 1, 75 percent of the progeny are *palustris* (assuming that the parent was a *palustris* form) and are of the rich race, while in Fig. 2 (assuming the parent to be *palustris*) the progeny are of the poor form, only 40 percent being the *palustris* form. This, however, is only hypothetical in this case. Nothing but actual experimentation can give accuracy to this phase of the subject.

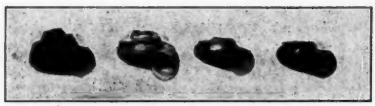


FIG. 3.— Variation in Valvata. 1. *V. tricarinata* Say. 2. *V. tricarinata confusa* Walker. 3. *V. bicarinata* Lea. 4. *V. bicarinata normalis* Walker. All enlarged.

In some other groups of shells the variation is along certain definite lines and the species seem to be more stable. For example, among the land shells *Polygyra profunda* and *Polygyra multilineata* vary in lacking or having bands, the uniform varieties being light (albino) or dark. *Polygyra tridentata* varies in its aperture

from no teeth through one, two, to three teeth. Some of the forms of Polygyra may be perforate or imperforate (*Polygyra monodon*, for example). In Valvata (Fig. 3) the variation seems to be still more marked, the variant being in the number and position of the carinæ; for example, *Valvata tricarinata* has three carinæ (1); var. *confusa* has two carinæ (2) and another variety has one carina. So also with *Valvata bicarinata*, which has two carinæ (3) while the variety *normalis* has three carinæ (4). *Vivipara contectoides* is another example in point, the typical form being banded, while a variety is without bands. These variations would seem to conform to de Vries's retrograde varieties, differing from the parent species in the absence of one or two characters. The majority of the latter examples are true varieties, lacking some characteristics of the type form, while the variations of Lymnæa are mutations combining most of the characteristics of the parent form. It is to be noted, however, that these two conditions overlap each other, so that no sharp and fast line can be drawn between them.

Some of the paleontologists have hailed de Vries's theory with delight, for they say that it is only in the light of such a theory that the sudden appearance of marked types in certain ancient faunas becomes intelligible. May it not also account for the finding of certain new species in regions supposed to have been thoroughly explored? May it not also account for the sudden disappearance of certain species, the mutations dying out but the parent form still continuing? A case in point is *Lymnæa shurtleffi* described from an artificial pond at Weatogue, Hartford Co., Connecticut. This species was found in large numbers, together with a new variety of Planorbis (*P. circumstriatus* Tryon). The finding of this Lymnæa is thus described by Mr. Tryon:[1] —

"The circumstances under which this and the following species were found are so peculiar that it is with great hesitation that I have ventured on a description of either of them. That new species of these shells should exist undetected in sections of the United States which have been so well explored by assiduous naturalists would be surprising; but in the present instance the almost irresistible supposition is, *that these species are of very*

[1] *Amer. Journ. Conch.*, vol. 2, p. 112, 1866.

recent origin [italics mine] in fact, *contemporaneous with that of the body of water which they inhabit.* I have looked in vain for some evidence upon the specimens themselves of the effect of some strong local influence. The species are so distinct that they afford no clew to a possible derivation from others.

"In conclusion, I present the following interesting particulars:

"Extract from a letter from the late Dr. S. Shurtleff to Isaac Lea, Esq., Weatogue, Hartford Co., Connecticut, November 22, 1865.

"In the summer of 1860 I made an excavation some two rods below a spring that flows about eight months in the year. The spring comes from a neighboring hill. The overlying rock is New Red Sandstone. From the time of the excavation till the summer of 1864 there was water in the artificial pond. It was dry in 1864, but I did not examine for shells, as before the excavation I had repeatedly examined the spring, but never found shells of any description.

"After my return from Pennsylvania, in September, 1865, accidentally crossing the pond, which was dry, I noticed quantities of shells clustered in the hollows. I gathered a few and laid them by for leisure examination; when I came to look at them again I found *L. umbrosa,* as I supposed, as well as a non descript species. I immediately went to the pond and secured all the Lymnæans I could find— some alive and many dead; and, fearing the dry season would destroy them all, I put many of the living shells into a pond that I have since made, that will never dry up. I may have collected 50 specimens of *L. umbrosa* (?) and of other specimens a half-pint.

"How these shells came into the pond is as much a matter of surprise to me as it is to you. I have no knowledge that there was ever a shell put into the pond.

"One fact more. The spring and pond are perfectly isolated, as the overflow disappears at the edge of a sandy plain in less than ten rods from its fountain head, and there is no stream of perpetual running water within one mile of it. The Farmington River is about a mile distant in the valley below, and here the only species yet found are *Lymnæa columella* Say, *Physa heterostropha* Say, *Planorbis bicarinatus* Say, *Vivipara decisa* Say, *Unio complanatus* Solander, and *Unio radiatus* Lamarck.

"The pond is two hundred feet above the bed of Farmington River."

Tryon says: "Besides the above two species I found a single specimen of *Lymnæa umbrosa* Say, and several of *L. desidiosa* Say."

From the foregoing account it would appear that *shurtleffi* (Fig. 4) was an offshoot (or mutant, if we apply the de Vries theory) of *umbrosa*[1] (= *elodes* = *palustris*), that being the only other species present (save *desidiosa*, which belongs to quite another group of Lymnæas). It may be thought by some that *shurtleffi* might have been produced by unfavorable conditions, but as the shells, one of the original lot of which was recently examined by the writer, are perfect and not distorted, this could hardly have been the case. All the evidence points to the conclusion that *shurtleffi* is a new species evolved or given off from *palustris*. The short, acute spire, subcylindrical, compressed body whorl, the partly open umbilicus, and the long and narrow aperture are the principal characteristics of the new species.

FIG. 4.— *Lymnæa shurtleffi* Tryon. Cotype. From Weatogue, Connecticut. Enlarged.

The foregoing remarks are not made with the idea of fastening the mutation theory upon the Mollusca, but only to call attention to these apparently analogous cases of mutation and variation to the end that other zoölogists may take up the matter and by experimentation and by the study of abundant material from various localities gather a large amount of data bearing upon this theory as applied to the Mollusca.

While the mutation theory seems to fit in very nicely in explaining the very large amount of variation in the fresh-water pulmonates, we must not be too hasty in applying this new theory, founded as it is upon plant variation, to animal life. Dr. J. A. Allen, in a

[1] *Umbrosa* is placed by some conchologists in the synonymy of *reflexa*. I have examined the type specimens in the Philadelphia Academy and they are good examples of *elodes*.

recent number of *Science*[1] calls attention to the danger of accepting this hypothesis without more conclusive proof, and I cannot do better than to close this communication with his remarks. He says: "While the mutation theory may be a good hypothesis to consider in respect to these peculiarly unstable groups of birds, it must be noted that the method of their origin and the results, as now known, are very unlike the methods and results of mutation in plants, as made known by de Vries. The facts and conditions are not to any great extent parallel. Instead of the resultant 'mutants' remaining constant and breeding true, as in the case of primroses, they are in this case unstable and are believed to interbreed freely with each other and the parent stock."

I am indebted to the following gentlemen for assistance in the preparation of this paper: Dr. Henry A. Pilsbry, Academy of Natural Sciences, Philadelphia, Pa., for the loan of a type specimen of *Lymnæa shurtleffi*; Mr. L. E. Daniels, La Porte, Indiana, for specimens of *L. palustris* from Minnesota; Dr. W. A. Nason, Algonquin, Illinois, for specimens of *L. palustris* from Michigan; and Mr. Frank M. Woodruff, Chicago Academy of Sciences, for making the excellent photographs which illustrate this paper.

CHICAGO ACADEMY OF SCIENCES

[1] "The Probable Origin of Certain Birds." *Science*, n. s., vol. 22, p. 431, 1905.

NOTES ON THE GENUS LEPTOPHRYS

WILLIAM A. KEPNER

In the year 1869 Hertwig and Lesser published in the *Archiv für mikroskopische Anatomie* (Supplement zu Banden 1–8) an article entitled "Ueber Rhizopoden und denselben nahestehende Organismen." On page 57 of this volume they describe a new genus which they name Leptophrys. The following is their diagnostic description of this genus: "Body variable in form, sheet-like with processes put out, pointed and unbranched pseudopodia, which are chiefly found at the end of the processes; the parenchyma is filled with small non-contractile vacuoles nearly equal in size"; and though they saw but three bodies in a *single* individual which they took to be nuclei and failed to see nuclei in any other specimens, they add: "Nuclei in great number." The color or its absence in the "pearl-like" granules served them as a basis for distinguishing the two species, *L. cinerea* and *L. elegans*.

In December, 1904, I discovered in some water taken by Mr. William G. Lapham from an oozy bank near Afton, Virginia, a large Vampyrella-like specimen (Fig. 1), which except for the absence of nuclei and the variable size of the vacuoles answered in detail to *Leptophrys elegans*. In size the creature would cover a circular surface whose diameter was 80 micra. It was very active, constantly changing its form laterally, though dorso-ventrally it maintained a film- or sheet-like structure which was about 5 or 10 micra thick. The protoplasm was highly vacuolated by non-contractile vacuoles. The degree of vacuolation varied at different stages of vital activity. When most highly vacuolated the vacuoles approached equality in size. The body was also marked with numerous, more or less equal, "pearl-like" granules. The rather short, unequal, pointed, and unbranched pseudopodia were given off from the margin of the body. They contained no vacuoles nor refractive granules. When vacuoles and refractive granules were pushed out they formed processes which might bear one or more pseudopodia. Most of these were given off from an absolutely transparent marginal layer of protoplasm. Subsequently

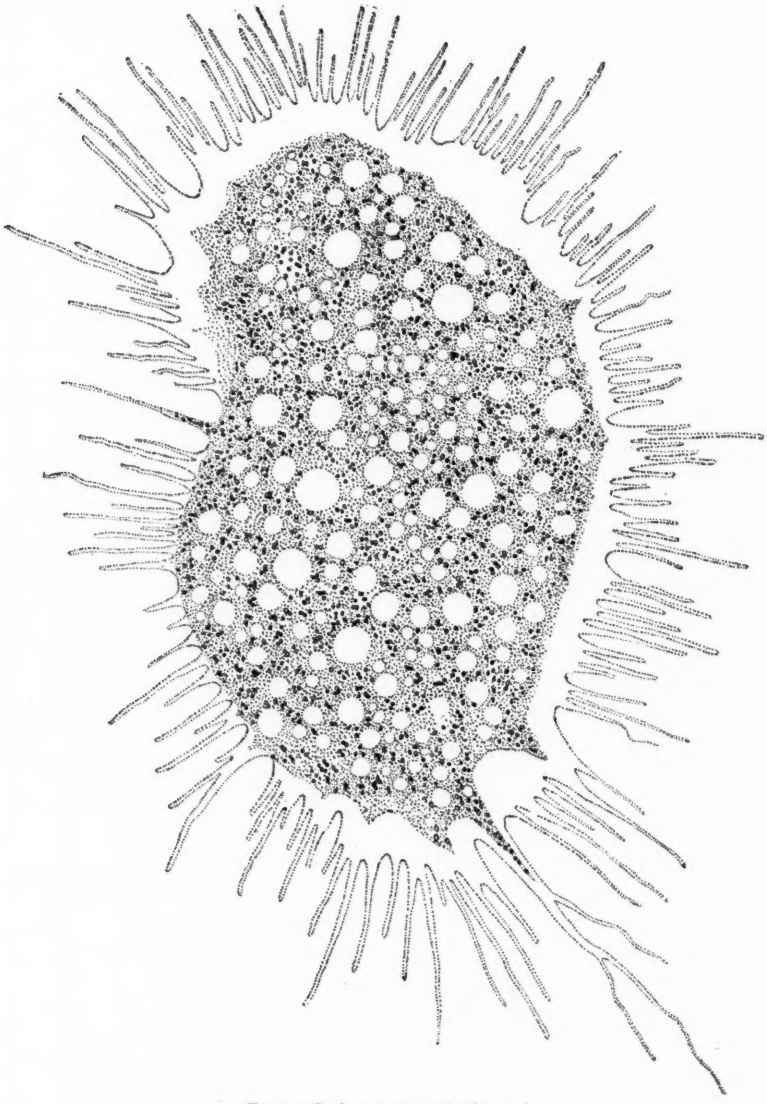


FIG 1.— Scale : 1 mm. = 1 micron.

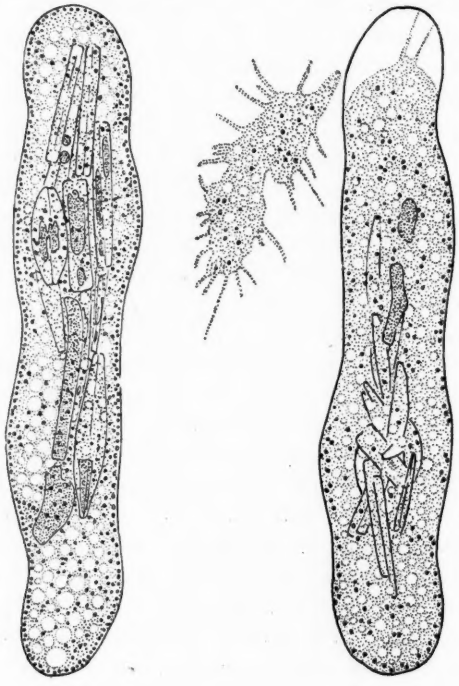
numerous specimens were found which did not show such a clear margin. Many specimens were seen which were quite free from food particles, but no staining of these would bring out a differentiation between the refractive granules and what might have been taken for nuclei. The figure of Hertwig and Lesser leads me to suspect that what they had taken for nuclei with central "nucleoli" were monads ingested as prey. It is unfortunate that they did not state how they determined these bodies to be nuclei.

Locomotion is effected by a more or less active amœboid movement. An active large individual tosses itself about very much as a cloud of smoke is distorted by a current of air. On the other hand the movement may be slow and deliberate.

The large individual represented in Fig. 1, took in as food diatoms, desmids, and what may have been several Infusoria. On March 22, 1905, in a bottle, that since March 12 had contained living *Chlamydomonas reticulata*, I found numerous specimens some of which belonged to *L. cinerea* and others which I had to place under the species *L. elegans*. They were feeding upon the Chlamydomonads. In one case I saw an individual that had ingested at least 25 Chlamydomonads. These flagellate forms after being ingested were greatly reduced in size. One specimen was found which had ingested a single *Navicula* sp. The ingestion of food was carefully observed. It was done, so far as could be seen, just as an Amœba envelops its food, but the closing of the ectosarc about the prey in the fashion of an iris diaphram could not be made out. The food appeared to be partially digested while the animals moved about. This inference is based upon the broken-down appearance of the ingesta. The food is eventually assembled into a common vacuole more or less centrally disposed.

Some time after the animal has gorged itself with food, or formed a central common vacuole of food, it withdraws its pseudopodia and enters into an encysted condition. Numerous cysts have been seen and studied. A single individual has been observed ingesting food and was followed through its complete encystment. From the time when the animal had quieted down and ceased to ingest food to when it left the cyst, a period of five hours had elapsed. The cyst varies in size and shape, depending upon the size of the

animal and the amount and form of the food. When the food vacuole contains rounded bodies like Chlamydomonads the cyst is spheroidal in form (Figs. 5 and 6). One animal was seen encysted about a single *Navicula* sp. In this case the cyst was oval (Fig. 4); in Fig. 2 is shown an encysted individual which had



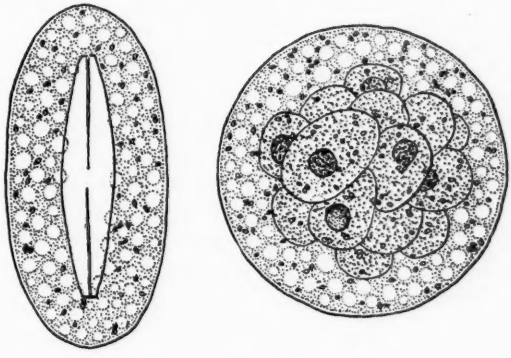
2 3

FIGS. 2 and 3.—Scale: 1 mm. = 1.18 micra.

a food vacuole of numerous long bodies that determined an elongated cyst. The animals vary greatly in size. Fig. 1 represents an individual that is somewhat larger than the average; the cysts of course are found to vary as greatly in size.

Upon encystment the animal is colorless or nearly so (Fig. 5). During encystment a color is assumed in some cases, which seems to depend upon the character of the food that is being digested.

In cases where Chlamydomonads were being digested and reduced in size the food lost its green color and gradually became dark brown (Figs. 5, 6). As this proceeded the refractive granules and the protoplasm took on a brownish tint, which was evidently due to products of assimilation (Figs. 6, 7). On the other hand in two observed cases where diatoms, desmids, and Infusoria were being digested, no coloration was noted (Figs. 2, 4). During the early part of the encystment the vacuoles are not conspicuous. As the end of the encysted condition approaches the vacuoles become more prominent. The cyst may rupture at one, two, three, or four places, and the contents escape through the clefts. In the



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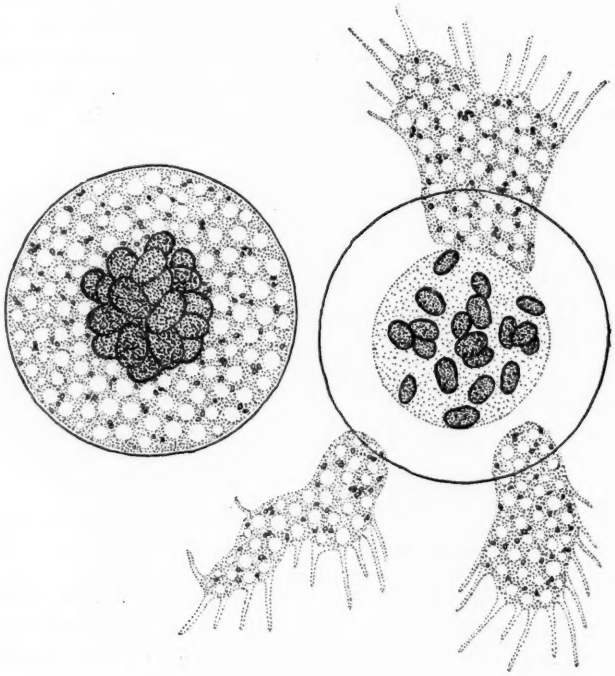
FIGS. 4 and 5.—Scale: 1 mm. = 1 micron.

large cyst shown in Fig. 3 the protoplasm streamed out at a cleft in the apparent upper right hand corner of the cyst. As the protoplasm flowed out it broke accidentally into four greatly unequal portions. Each part, though no two were equal in size, became a complete individual. These daughter individuals were almost colorless. In the forms that had been feeding upon Chlamydomonas the contents emerged at two, three, or four clefts in the cyst membrane (Fig. 7). In all these cases the daughter individuals came out of the cyst colored *light brown. As they lived an active life their color decreased.* Beneath a single cover-glass all degrees of coloration were easily found. The transparent ones answered to Hertwig and Lesser's description for *L. elegans.* The

brown ones as they leave the cyst, I take to be their *L. cinerea*. In as much as they had not seen any specimens ingest food and had observed no encystment I am led to believe that what they studied and described as two species were but different nutritive conditions of individuals of the same species.

In November, 1904, Mr. Lapham observed a large colorless



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FIGS. 6 and 7.—Scale: 1 mm. = 1 micron.

individual divide into daughter parts of protoplasm to each of which the food enclosures had been equally distributed. In March, 1905, I observed one of the individuals found living with *Chlamydomonas reticulata* divide into daughter forms. The process was rather slow. It began with the formation of two fan-shaped parts, connected by a wide neck (Fig. 8). This neck became more and

more attenuated until at the end of 35 minutes there was the merest strand of protoplasm connecting the two parts, which had now moved 500 micra apart. This strand suddenly snapped and the fragments moved away as two new individuals. While this process was going on one of the parts ingested a Chlamydomonas. Except for this there was not a trace of ingesta within the dividing protoplasm.

These observations seem to afford reasons for setting aside Hertwig and Lesser's two species, *L. cinerea* and *L. elegans*; and the fact that, although there was ample opportunity to demonstrate nuclei such as Hertwig and Lesser describe as seen in part of a single individual, no evidence of their presence was obtained, leads to the conclusion already suggested by Penard that the genus Leptophrys is but a synonym for a species of Vampyrella.

The variation in the form of the cysts of this Vampyrella and the two cases of binary fission, independently observed by Mr. Lapham and myself in this species, are of interest. Attention is also called to the

FIG. 8.—Scale: 1 mm. = 4 micra.

apparently accidental division of protoplasm that takes place where there is no centralized nucleus.

I am indebted to Mr. A. H. Tuttle, of this laboratory, for suggestions of value to me in preparing this article.

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EGG-LAYING OF CRAYFISH

E. A. ANDREWS

In crayfish, as in related Crustacea, the eggs are carried fastened to the limbs of the abdomen during the long period of development that precedes their hatching. As the openings of the oviducts are upon the thorax, the eggs have to be transported some distance to reach the abdominal limbs. It is the purpose of this article to describe some of the activities of the female associated with the extrusion of eggs from the oviducts, their transportation to the limbs of the abdomen, and their fixation there.

In a crayfish in France, a species of Astacus, some of the behavior of the female in laying was long since made out by Chantran (*Compt. Rend. Acad. Sci. Paris*, vol. 71, pp. 43–45, 1870; vol. 74, pp. 201–202, 1872) in his long continued and careful study of the life history of the crayfish. His too brief statements are as follows. The female crayfish stands up and for several hours secretes a viscid mucus from the limbs of the abdomen. It then lies down upon its back with the abdomen bent forward toward the openings of the oviducts, in such a way as to form a sort of chamber, in which, on the following night, the eggs were received as they were expelled from the reproductive organs. In different females the expulsion of eggs lasted from one to several hours. The eggs were plunged into the mucus which, as it were, bound the edges and the end of the abdomen to the thorax and also helped to make the boundary of the above mentioned chamber or basket. In this chamber there was some water as well as eggs and mucus. All the eggs were laid at one period and rarely were any laid in the day time.

Observations upon the laying habits of an American crayfish, *Cambarus affinis*, as published in this journal (*Amer. Nat.*, vol. 38, pp. 165–206, 1904) showed a close agreement with the above account. Renewed observations upon the same species in April, 1904, have added more details and verified suppositions previously made to bridge over gaps in observation of actual extrusion and transport of eggs.

The activities of the female connected with egg-laying may be divided, for convenience of description, into four periods. First, the preparatory cleansing of the under side of the abdomen and thorax. This lasts four or five days and has been described in the previous paper. Second, the period of secretion of mucus, or "glairing" as we may call it, to be described below. Third, the period of actual extrusion of eggs, previously inferred but described below as actually seen. Fourth, the rhythmic alternation of position of the body, or "turning," lasting several hours and described in the previous paper.

All these processes precede the long care of the eggs as they hang fastened to the abdominal legs for from five to eight weeks till they hatch, after which there is a brief period of association of female and young before the latter scatter and become independent.

The least well observed process is that of secreting glaire from the glands of the abdominal appendages and sterna. It always follows the long and very laborious cleansing of those surfaces and immediately precedes the extrusion of eggs so that as soon as the glaire is ready and the female properly posed, the eggs pass out into the glaire, one period passing insensibly into the other. At the time of secretion the female is still easily alarmed and moreover the glaire is at first seen with difficulty as it is like water in refraction, so that in most cases the "glairing" period escaped observation. But as far as was made out the secretion of the glaire took less than half an hour, though Chantran speaks of Astacus as secreting mucus for several hours. Possibly some of this time was taken up with "cleansing," which has not yet been noticed in Astacus. But if there is an actual time difference between Cambarus and Astacus it may be due to differences in temperature since Astacus lays in winter and this Cambarus in spring.

The details of the activities of a crayfish observed during the "glairing" process were in one case as follows. At first the animal kept the same unusual attitude assumed in cleansing itself, that is, it stood high up on its legs with the thorax and abdomen raised far above the bottom. The abdomen was bent forward loosely and its caudal fan reached nearly as far as the

middle of the abdomen. The small limbs of the abdomen, the pleopods, swung slowly back and forth with interruptions and then, after three minutes, flapped actively back and forth. Three minutes later the crayfish gave up this attitude and crouched down and turned slightly over to one side while still swinging the pleopods and also making very active fanning movements of the exopodites of the maxillipedes. After four minutes the crayfish again stood up and swung the pleopods back and forth for five minutes and then a faint halo of glaire was first detected about the pleopods. The abdomen had now become bent forward in a curve so that it resembled a half-closed hand and the space so enclosed seemed filled with an almost invisible glaire. When the pleopods inside this mass moved there resulted a jerky movement of dirty lines where the glaire and water met at the anterior opening of the chamber formed by the bent abdomen. Two minutes later the animal ceased to stand up and lay upon its left side with all the right legs high in the water, but after lying thus for two minutes it turned onto its ventral side and crouching prone, raised its third, fourth, and fifth legs on the left side, but coming against the side of the dish, did not roll over onto its right side as was expected. By this time the long continued and increasing contractions of the muscles of the abdomen had flexed it so far forward that the tail-fan reached to the bases of the second thoracic legs, leaving only the mouthparts and the bases of the chelæ and second legs exposed to view. The pleopods were still moving rapidly back and forth inside the glaire chamber. Two minutes later, some of the legs on the right side were raised and the animal seemed about to turn over onto the left side but it returned to the ventral position. The abdomen had now become flexed even more powerfully so that its terminal piece, the telson, reached to the bases of the chelæ, or first thoracic legs, and it was pressed upward against the thorax so that some of the slightly turbid glaire was forced out from between the tail-fan and the thorax. With the abdomen thus carried forward under the thorax, the animal remained six minutes crouching down so that anteriorly the ventral side of the thorax was near the bottom of the dish while posteriorly the *dorsal* side of the abdomen rested upon the bottom. Then all the right legs were raised and the body slowly

swung about through 120° till the right chela came against the end of the dish and the animal turned over onto the left side and rested with the anterior part elevated and the abdomen upon the bottom. Lying thus for some minutes the crayfish made no movements of any external organs. The tail-fan had receded a little but was still as far forward as the bases of the second thoracic legs.

Two minutes later, *i. e.*, about half an hour from the beginning of the "glairing" process, the continued recession of the abdomen laid bare the bases of the third legs and over the edge of the telson an egg was seen in the glaire above the telson. Thus the glairing period had already passed and the extrusion of eggs had been going on. A minute later the withdrawal of the abdomen stretched the glaire like a membrane from the edge of the telson to the region of the anterior thoracic legs and through this veil rows of eggs were seen issuing out from the opening of the oviduct on the base of the third right thoracic leg. The extrusion of eggs, however, will be described below from other more normal cases in which the crayfish lay upon its back and not upon one side when the eggs were extruded.

The actual extrusion of eggs was seen in six crayfish and took place in approximately the following number of minutes in these cases: 10, 10, 13, 17, 20, 30. This is in strong contrast to the statement of Chantran that, in Astacus, the extrusion of eggs lasted from one to several hours. Possibly he confounded the period of extrusion with the following period of "turning" which may well exist in Astacus and which in Cambarus occupies several hours.

In Cambarus as in Astacus it was very unusual for eggs to be laid in the day time and the above six cases were seen in the day time only from the employment of the following expedient. Crayfish that had finished the cleansing process were prevented from laying by being kept all night in running water barely sufficient to moisten them and then put into deeper water in the day time. After two or three repetitions of this treatment some ten females laid in the day time, several hours after being put into deep water.

Though no crayfish laid when merely moist, one small specimen

laid in water so shallow that the animal could not cover its back when crouching down as close to the bottom as possible. This female carried on some turning movements after laying and after forty-three days the eggs, apparently all of them, hatched out, contrary to expectation.

Some individuals, however, could not be forced to lay in the day time even by numerous repetitions of the alternating conditions. Such crayfish did not lay at all, yet when examined some were found to have the ovaries full of large eggs. Others kept for two months gradually resorbed the ovarian eggs. In such ovaries the old eggs were reduced to isolated, irregular yellow masses scattered throughout the ovary, while translucent new and minute eggs filled in much of the space between the degenerated eggs.

In the cases of egg-laying observed under the above forced conditions the extrusion of eggs followed after a thorough cleansing of the region that then secreted copious glaire. By the bending of the abdomen there was then formed a chamber, or basket, full of glaire, a sort of "incubatory pouch" which received the eggs and in which they were made fast to the pleopods. The way in which the tail-fan expands to close in this pouch and the part played by the glaire, or mucus, were well described for Astacus by Lereboullet in 1860 (*Ann. Sci. Nat.*, zoöl., ser. 4, vol. 14).

Being thus provided with a basket full of glaire the female after a few trials lies down upon her back, a most remarkable position considering the energy with which such crustaceans avoid it and escape from it at other times. The flexure of the abdomen becomes so excessive that the telson is brought up as far as the bases of the chelæ, or even to half cover them, and thus the glaire is smeared over all the ventral surface of the thorax near the oviduct openings upon the bases of the third, or middle, pair of legs. The eggs will thus come out into a bag of glaire and though laid under water they are not laid into the water. The gradual relaxation of the abdomen finally uncovers the bases of the third pair of legs so that the eggs may be seen coming out of the oviducts. This withdrawal of the abdomen does not, however, expose the eggs to the water since the viscid glaire that has been put upon the thorax is drawn out from the thorax to the

receding telson like an apron that covers over the eggs and prevents them from falling out even when the female turns right side up. This is the condition indicated in Fig. 5 of the preceding article in this journal.

While the eggs are emerging, the crayfish is almost motionless, lying supine with stiffly outstretched limbs and open claws as if dead. If now removed from the water and held in the hand the crayfish responds but little and the flowing out of eggs continues and may be more closely watched.

The mouths of the oviducts are widely open and remain fixed in that state when the crayfish is plunged into boiling water. It is then seen that the oval membrane that usually covers the opening is pulled outward like a curtain leaving a somewhat triangular orifice bounded on the external edge by this drawn curtain and on the median edge by the rounded rim against which the curtain comes when it is closed. Deep inside the large orifice opens the smaller oviduct tube full of eggs, each filling the tube from side to side. These eggs are also fixed by the heat in something of their natural irregular form. In life the eggs come out distorted by pressure and are so soft and flowing, like liquid in thin bags, that they mutually flatten against one another and become indented by contact with solid objects.

The eggs generally emerged in two streams one from each oviduct, but in some cases only one oviduct was used for a long time. The rate at which the eggs came out varied from 12 to 60 a minute on each side. With some stoppages and changes in speed some two to six hundred eggs were laid, by different females, in less than half an hour. Frequently the eggs came out in sets of three flattened together and the last one of the set rounded itself off during the brief pause before it was pushed away by the coming out of the next set. Thus the mouth of the oviduct was alternately taken up with one rounded egg and with three flattened eggs. When the end of deposition drew near, a gradual ending was brought about in one case by a cessation of all flow for two minutes and then the emergence of only two eggs, the last to be laid. When this animal was dissected an hour later the ovary was empty save for three eggs in the posterior lobe and two in the left oviduct and one of these slipped out of the mouth of the ovi-

duct when the ovary was being removed. Both oviducts were greatly distended, though for a long time only the right one had been discharging eggs.

The glaire into which the eggs come is dense along the edges of the abdomen and can be picked up by forceps as 'blobs' that hang down a half inch or so, supporting their weight. But the rest of the glaire is too weak and watery to be pulled away. When the abdomen was forcibly bent back to examine this glaire and the female prevented from laying for a night there was no second secretion of glaire over laying though cleansing movements were carried on again. When the crayfish laying eggs was suddenly put into boiling water the glaire coagulated sufficiently to form an opaque white mass over the eggs in the posterior part of the abdominal basket but the glaire over the issuing eggs did not become opaque enough to hide their red color.

The transfer of the eggs from the oviducts to the pleopods within the abdominal chamber is purely the work of gravitation. Though the crayfish lies upon its back the abdomen is always lower than the thorax and in some cases several legs were actively braced against the bottom of the dish in a manner to exaggerate this sloping of the body. In one case the animal sat propped up at an angle of nearly forty-five degrees supported upon its short fifth legs and upon the abdomen. Generally, however, only the tip of one chela and one leg touched the bottom and thus gave more stability to the animal as it lay upon its rounded back.

The deep groove between the bases of the thoracic legs favors the backward flow of the eggs which coming from each oviduct unite in one stream that flows along the thorax onto the abdomen and there divides to flow right and left along the bases of the pleopods. When, as is often the case, the animal lies with one side higher up than the other the eggs coming out of the more elevated oviduct drop some 6 to 8 mm. diagonally across the body before reaching the sternal surface. In such positions also the eggs accumulate in the lower side of the abdomen and when the animal is taken in the hand the eggs will flow right and left in the abdominal chamber as right or left is held lower. The glaire is thus not dense enough to stop the movement of eggs except at the edges of the chamber and upon the pleopods. Even after

the period of extrusion and six minutes after "turning" had begun, when an undisturbed female was taken out of the water many of the eggs in the chamber ran over from side to side and tended to escape at the angle between the abdomen and the thorax on each side. Some of the eggs were then loosely attached to the pleopods, but when the abdomen was forcibly straightened out and held downward many of the eggs glided off over the end of the telson.

Though the details of action of the female at the time of extrusion of eggs were different in other cases the following special case is thought to be, in the main, typical. A crayfish lying upon its back with the telson so far forward over the thorax as to reach to the posterior edges of the second legs showed no movements of any organs for a minute and then only a slight motion of the antennules and of some legs. After four minutes more there were some slight movements of the third legs and of the left chela. The right chela rested upon the bottom of the dish and so held the animal in more stable equilibrium. By this time the slow relaxation of the abdomen had let the telson glide so far back that the bases of the third legs were nearly uncovered. Three minutes later by looking in under the telson one could see eggs coming out of the openings of both the right and the left oviducts, which openings are upon the bases of those legs.

Where the tail-fan had been over the thorax, as far forward as the chelæ, there was left a layer of glaire. On counting the eggs in the issuing streams, still three minutes later, they seemed to come out at the rate of one a second on each side. The only movements of the animal were a temporary fanning motion of an exopodite near the mouth. But five minutes later the animal had turned to lie with the left side somewhat elevated and the eggs were seen falling out of the oviduct of that side across the body then to glide back into the abdominal basket. A minute later they were coming out at the rate of ten in sixty-five seconds, in groups of two or three at one jet and then an interval before the next row of two or so. In another minute there were signs of life in the rapid fanning of exopodites on the left of the mouth, which continued for a minute, nearly stopped, and then started again. After a minute more there were added a rolling of the

entire body onto an even keel and then a violent struggling of the legs as if to turn the body over into the normal prone position. Eggs were still seen in the mouths of the oviducts, two on each side. In this struggle to regain the ventral position the left side was down for a minute and then the right for a minute when the right going under and the left uppermost the animal got onto its ventral side. It then stood thus, on its legs with ventral side down, for two minutes with only slight movements of two or three legs. Immediately after this brief rest the "turning" movements began. This would no doubt have gone on for several hours but it was checked by interference after six minutes during which time there were fairly regular alternations of pose, this animal lying down first upon its left side and next upon its right.

It is in these turning movements that always follow the extrusion of eggs, that the eggs become fastened to the pleopods, so that when the female a few hours after the eggs have come out, for the first time straightens out the abdomen and the glaire is seen only as shreds hanging from the edges of the abdominal terga and from the tail-fan, the eggs do not fall into the water but henceforth hang suspended from the pleopods, till hatched.

While fastened to the pleopods the developing eggs are protected by the female and also aërated by special movements of the pleopods which are the more energetic the more the water tends to be stagnant or poor in oxygen. In all probability eggs not attached to the pleopods would never develop, in nature, and this attachment seems an essential part of the life history, here, as in many other Crustacea.

Just how the fastening of the eggs takes place is by no means clear. A microscopic examination of the so called "cement glands" upon the sterna and all the six pairs of appendages of the abdomen showed that in Cambarus, just as in Astacus, these glands contain the material from which the "glaire" is made. The same reasons that led Lereboullet (*l. c.*) and later Braun (*Arb. zoöl.-zoöt. Inst. Würzburg*, vol. 2, 1875) to believe that in Astacus this secretion fastened the eggs to the pleopods, apply in Cambarus and there is little doubt that this glaire plays the most important part in fastening the eggs. However, the remarkable fact that in both these crayfish as in crabs the eggs are fastened

almost exclusively to *hairs* upon the pleopods and upon the sterna calls for explanation. In crabs Williamson (*22d Ann. Rep. Fisheries Board for Scotland*, 1904) has recently described special hairs upon the pleopods as piercing the outer egg-case and liberating an adhesive substance contained between the inner and outer part of the egg-case. His idea is that the eggs are first impaled in a row upon a hair, as upon a skewer, and subsequently fastened to the hair by the collapsing of the pierced outer egg-case and by the adhesive material contained within it. As Williamson sought to extend this view to the lobster and other Macrura, the crayfish, Cambarus, was reëxamined in April, 1905, to see if this view would apply here, but no evidence of such skewer action of hairs was found though on the other hand no *absolute* refutation of such a view was obtained.

In *Cambarus affinis* preserved eggs have in the ovary a case about $\frac{1}{3}$ μ in thickness as seen in optical section. When they leave the enveloping cellular follicle and are laid and for at least five hours afterwards, they have the same thickness of case but twenty-three hours after laying the case was (observed as above) 2 μ thick. In live eggs there is a remarkable change in elasticity accompanying this change in thickness of case. While the fresh-laid egg glides along like a liquid drop flattened and deformed by every contact and scarcely held together by its delicate case, the egg thirty-six hours afterwards is a tensely spherical ball, which, dropped nine inches onto a table, rebounds five inches and continues to bounce up and down five or six times before coming to rest. This great elasticity was noticed in Astacus eggs also, by Lereboullet. Such eggs, however, are normally hung to the pleopod by peculiar stalks. Each egg has its separate stalk and this is of elastic material comparable to the egg-case.[1] When this stalk was pulled out to four or five times its length, to ten times the diameter of the egg, it flew back like a rubber band, as soon as released.

These stalks are not formed until a little while, 15 minutes or so, after the eggs enter the abdominal chamber and at first they are

[1] In a few cases an egg had two stalks with a ribbon-like connection over the surface of the egg.

exceedingly delicate, soft, wide, flat bands. These are at first very short and only slowly become as long as the diameter of the egg, subsequently to become many times that and hard and narrow and twisted. In this latter state they remain after the egg hatches and connect the empty egg-case with the pleopod and are even then a means of salvation for the young.

Near the egg the stalk expands as a rounded tent, or bell-like membrane the edges of which are fast to the egg-case over a rounded area about one third the diameter of the egg. Optical sections indicate that the stalk continues by this membrane over the egg to make its thick elastic outer case while the thin inner case is the only one near the egg over the area covered by the bell. At this place only there seems to be a liquid separating the inner case from the walls of the bell. The stalk seems hollow for some distance up from the bell and one is led to infer that each egg is slung in a bag the closed mouth of which, when drawn out, forms the stalk. The stalk and bell look like glass, but have longitudinal creases that simulate a fibrillation. The other end of the stalk is continuous with a flat mass that binds together many of the plumose hairs along the side of the pleopod. In fact, these hairs seem rather completely invested in a secretion which holds them all imbedded in a flat mass on each side of the pleopod while from the edges of this mass hang out the egg stalks at intervals, every five or six hairs having their investment continued out as a free stalk for an egg. The stalks are like a fringe from a curtain in which the hairs are fixed; but many stalks arise from the flat sides of the curtain.

The structure of the stalk when magnified four hundred diameters is homogeneous on the outer surface but within is a clear matrix full of vesicles about $1\frac{1}{4}$ μ in diameter and elongated in the length of the stalk as if by the stretching of the matrix. When broken, in its early stages, the jagged edges of the stalk round off slightly as if somewhat paste-like.

Some facts that seem to increase the difficulty of applying Williamson's view to Cambarus are the following. One female was found in which the sterna and pleopods of the first somite were not clean and these alone had no eggs attached to their hairs so that the painfully laborious process of cleansing seems necessary

for attachment of eggs, and this is more readily reconcilable with the idea that a secretion flows out over the cleansed surface to fasten the eggs than with the idea that the hairs puncture the egg-case and so liberate the material for fixation.

The "perivitelline space" which is held by Williamson to contain the adhesive material in crab's eggs seems to exist in Cambarus as the result of strong, abnormal osmotic changes only, which may accumulate liquid between the inner and the outer parts of the egg-case, when for instance an egg is plunged into strong Flemming's liquid this may accumulate in local blisters of the outer membrane.

Ovarian eggs were not sticky unless allowed to dry upon the surface when they, *either with or without the enclosing cellular follicle*, stuck to a needle and might be pulled up into club-shaped drops that then sprung up to hang as bulbs connected to the needle by a minute stalk.

The glaire, however, sticks slightly to dishes and to a knife and when eggs were taken out of the glaire from the front part of the abdominal chamber where they had not yet made stalks (though others in the back part had done so) and put into a watch glass of glaire, they stuck together more firmly than when left in water. The connection of these eggs with one another after 48 hours was by delicate fibers something like early stages of egg stalks and such eggs after fifty-eight hours were elastic so that they rebounded five or six inches when dropped nine. Thus in glaire the elastic case and something like a stalk were made when isolated from pleopods and hairs. Again, eggs broken off from very young stalks and left in moist air adhered together very firmly and also to a dead pleopod. These facts seem more readily explained by the action of the glaire than by an assumed early pricking of the hairs.

A microscopic examination of the material that binds the plumose hairs together, made some hours after the eggs were laid, showed that in some places this mass was a dense, clear, highly refracting sheet, moving and breaking under pressure like a stiff jelly, and identical with the stalks of eggs, while in other places the material on the hairs was a milky gray matrix that rounded itself off like a viscid fluid when broken and was full of droplets

like those inside the cement glands. It may be that the secreted glaire passes from the latter state into the former.

The glaire itself resembles the stalks in being a clear matrix full of droplets that elongate when the glaire is stretched but while some of the droplets are $1\frac{1}{4} \times 12\frac{1}{2}$ μ others are as large as $37\frac{1}{2} \times 112$ μ and many are compound emulsive drops of 12 to 25 μ. Glaire and egg-stalk are thus not identical though the stalk might well arise from glaire matrix.

Without, then, imagining any special action of the hairs we may suppose that the eggs become fastened to them because they are smeared with the densest secreted matter from the pleopod glands. All the surfaces having been made scrupulously clean the secretion can spread over the hairs as they hang like feathers in the water and as the glands along the pleopod are segmentally or interruptedly arranged, the hairs may well be stuck together in small clusters or brushes of denser glaire separated by more watery glaire. When the eggs roll down along these brushes smeared with adhesive glaire they may stick to them as the brushes stick to one another all along the side of the pleopod. Once stuck and more or less buried in the glaire on the hairs the pull of their weight will drag out enough glaire to make a stalk. That more eggs stick to the hairs than to the body of the pleopod may be largely a matter of relative area.

Some eggs that were loose in the abdominal chamber when the rest had stalks, some hours after being laid, presented the following peculiar appearance upon one side. A rounded area agreeing with the size of the bell of a stalk was thickly set with minute drops on the outside of the outer egg-case while fine threads inside this case suggested that some filose, or else secretional activity of the egg might have been going on over this area through pores in the egg-case. As was known to Chantran, each egg has a large polar area and it seems possible that special activities of the protoplasm there may be concerned in localizing the attachment of the egg to the glaire on the hairs and aid in determining the bell-like area of the stalk.

SUMMARY

The egg-laying habits of *Cambarus affinis* are closely similar to those of Astacus, as far as the latter have been described.

In Cambarus there are four periods of activity: cleansing, glairing, extrusion, turning.

The transportation of the eggs from the oviducts to the abdominal appendages is accomplished by gravity when the female places herself in special positions.

The activities of the female include a prolonged use of special tools to cleanse the surfaces later covered by the secretions of the "cement glands," a long continued maximum contraction of the abdomen, a habit of lying supine and externally inert during oviposition, and a long rhythmic alternation of poses associated with the fastening of the eggs to the abdominal appendages. After this follow the weeks of aëration and care of the eggs till they hatch.

While the ultimate analysis of the factors concerned in fastening the eggs to the abdominal hairs awaits future investigations the secretion of the "cement glands" seems of chief importance though local activities of the egg may possibly play a part.

BALTIMORE, MD.

SOWERBY'S WHALE ON THE AMERICAN COAST

GLOVER M. ALLEN

A CENTURY has now elapsed since Sowerby's whale (*Mesoplodon bidens*) was first made known to science by James Sowerby ('04) in his *British Miscellany*. During this period barely more than two dozen additional specimens have been recorded and these have more often been to a greater or less extent imperfect. Flower ('72) in his account of the genus, listed but ten specimens of this species known by him to be at that time preserved in the museums of the world. Seven of these ten specimens were represented by skulls only, while of the three others more or less of the skeleton was saved. Turner ('89) gave the number of known records for the occurrence of this whale as nineteen, and a few more specimens have since been made known, so that the general characters of the species are now fairly well ascertained.

At the time of Turner's writing (1889) but two examples of Mesoplodon had been recorded from the western side of the North Atlantic. The first of these was stranded on Nantucket Island, Massachusetts, in 1867 (Agassiz, '68), and its length is recorded as 16 feet, 3 inches (J. A. Allen, '69, p. 205). The second American specimen was captured on March 28, 1889, at Atlantic City, New Jersey, and was secured by Dr. F. W. True for the United States National Museum (Turner, '89, p. 13). Nothing further was known of the species in American waters until 1898, when a young female was found dead on the coast at Annisquam, Massachusetts, in August. Its skeleton was obtained by the late Professor Alpheus Hyatt for the museum of the Boston Society of Natural History. Save for a brief mention (Hyatt, '99) this specimen has not been reported upon.

I am indebted to Mr. Thomas Barbour, of New York City, for the privilege of recording a fourth American specimen and the twenty-sixth hitherto known. Mr. Barbour has very kindly written out the following notes respecting this interesting capture.

"On the 22d of July, 1905, a large specimen of *Mesoplodon*

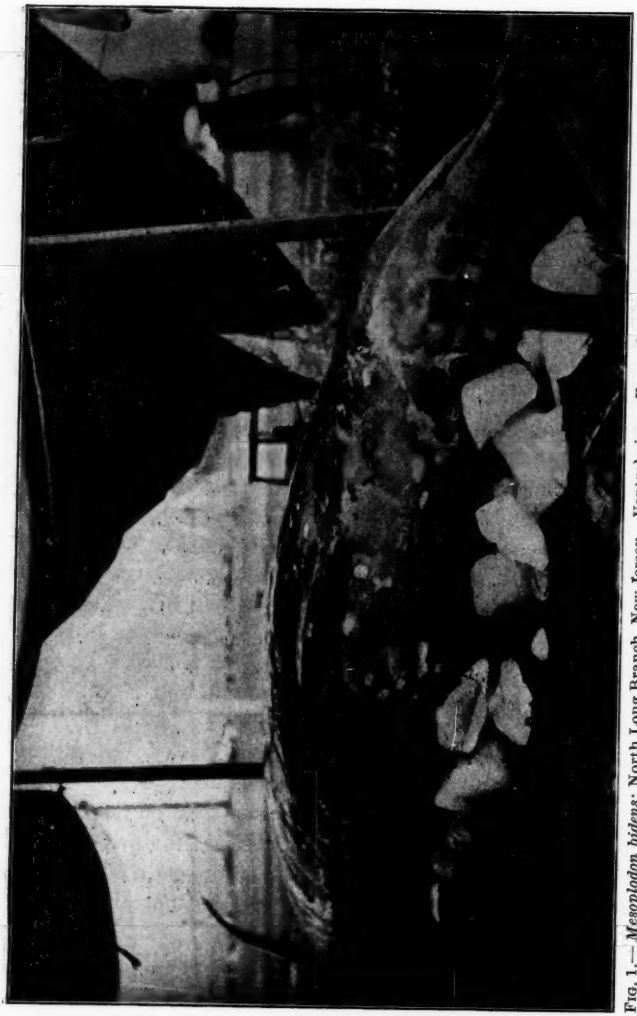

FIG. 1.—*Mesoplodon bidens*; North Long Branch, New Jersey. Ventral view. From photograph loaned by Mr. Thomas Barbour.

bidens became entangled in the pound-nets about a mile offshore from North Long Branch, New Jersey. It was rather exhausted when found, and was towed with some difficulty by two large power pound-boats to the beach, where it was secured by a rope. It soon died owing to injuries received during its capture.

"The total length of the specimen was said by the fishermen who measured it, to have been 22 feet. The coloration was very peculiar. The entire upper surfaces were slaty blue-black, the lower surfaces somewhat lighter. The sides and belly were dotted with numerous white spots, each varying from one to three or four inches in diameter. On the throat these patches became more or less confluent and very irregular in outline."

With some difficulty, Mr. Barbour succeeded in having photographs of this animal taken, two of which are here reproduced. The first of these (Fig. 1) shows the whale lying on its left side with the ventral portion toward the observer. The spindle-shaped form of the body, the small pectoral limb, and the beak-like snout are fairly well seen. As the anterior part of the animal's body was shaded by a canvas awning, the light spots and irregular throat-markings are distinctly seen in the photograph without the addition of light areas due to reflection, such as sometimes appear in photographs of parts taken in direct sunlight. The two diverging gular sulci are very well shown at the right-hand end of the figure, and are clearly not confluent at their anterior inception. One of these sulci (the lower in the figure) seems to be open, as though stretched apart by the dragging of the left side of the head. Fig. 2 is a view of the top and right-hand side of the head. The single crescentic blowhole with its extremities directed forward, is seen at *a*; what appears to be the right eye is seen at *b*. The very small mandibular tooth (*c*) is seen barely projecting from the gums and its small size indicates that the animal was probably a female. The lower jaw is clearly longer and broader than the upper, and a slight groove or gutter can be made out at the corner of the mouth.

The skull of this specimen was secured at considerable trouble by Mr. Barbour, and presented by him to the Museum of Comparative Zoölogy where it is catalogued as no. 7301. The mandibles and the rostral portion, however, were subsequently destroyed by an unfortunate accident.

It will be of interest to bring together a few notes on the Annisquam and the Long Branch specimens for comparison with other recorded observations on this species.

A considerable variation in the color seems apparent from the accounts of various authors, especially in respect to that of the

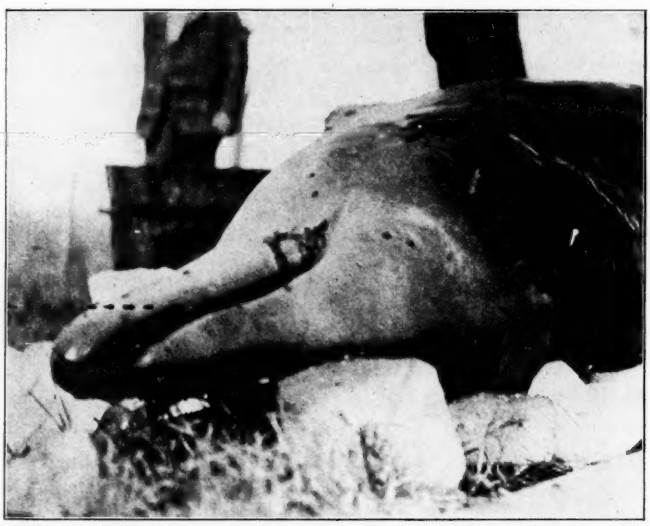

FIG. 2.— *Mesoplodon bidens*; North Long Branch, New Jersey. Top of head. *a*, blowhole; *b*, right eye; *c*, tooth. From photograph loaned by Mr. Thomas Barbour.

under parts. Turner ('89) summarizes briefly the descriptions given up to that time and concludes that there "can be no doubt .... that this animal is not of the deep black colour on the dorsum which one sees in Hyperoodon, but that the dark hue is dashed with a bluish tint, so that one may describe the prevailing colour of the back as dark bluish-gray or bluish-slate colour. The grey or whitish, almost circular spots.... are obviously also characteristic markings of the skin. The belly is not white but of various shades of grey, dashed perhaps with a bluish tint." Southwell and Harmer ('93), however, describe the female stranded at Norfolk, England, Dec. 18, 1892, as of a uniform black color, "not appreciably lighter on the belly than on the back," with a "perceptible bluish tint on the skin in a good light." They note also

the light streaks and blotches "most numerous on the side and ventral surface." The large fetus contained in this specimen was a male and had the under parts "white." W. Rothschild ('93) accordingly suggests that it may prove in this species that the males have the belly white, while the females have this region of much the same color as the back and sides, save for the light blotches already mentioned. The Long Branch female seems to be of this latter type of coloration. Grieg ('98) found that the male taken at Karmö was colored much as Rothschild describes, with the back a blue-gray becoming lighter on the belly, which was nowhere *pure* white but tinged with reddish. The clear color of the belly extended from the gular folds to the genital opening, and there were none of the roundish circular spots to be discovered. Evidently the coloration was much like that of the Havre specimen figured by Dumortier ('39). Most of the recorded specimens, however, have not been examined while in a fresh condition by a trained naturalist and the few descriptions of the external coloration are insufficient to settle the question of a sexual dimorphism in this respect.

Regarding the Annisquam specimen, no color notes were taken, but from a few small photographs in the possession of the Boston Society of Natural History, it appears evident that the ventral portion was of a lighter tint, and in one of the views a few oval whitish spots are seen on the side a trifle behind the middle portion of the body. Another view shows the convexity of the posterior margin of the flukes at the median point as well as the prominent dorsal fin. The lower jaw protruded slightly beyond the upper. Measurements of this specimen, as noted by Professor Hyatt, are as follows: total length, 12 feet, 2 inches; from anus to bight of flukes, 3 feet, 4 to 6 inches; across the flukes, 3 feet, 1 inch; from tip of rostrum to angle of mouth, 1 foot, $1\frac{1}{2}$ inches. The gular furrows were noted as about 10 inches long and from $\frac{1}{4}$ to $\frac{1}{2}$ an inch deep.

The bones of the Annisquam specimen were macerated and cleaned, and are now preserved in the collection of the Boston Society of Natural History. The skeleton presents several points of considerable interest and through the kindness of Mr. Charles W. Johnson, the curator of the Society's museum, I have been enabled to make the following notes.

The skull shows the specimen to have been rather immature as

the sutures are largely unclosed; moreover, the rostral cartilage had not ossified so that the thin overarching premaxillæ of the rostrum form a long tube nearly closed dorsally except for a slight space where these bones do not quite meet along the median line. The proximal portions of the premaxillæ just anterior to a line passing across the middle of the blowhole, are nearly flat; they then rise almost perpendicularly to the vertex of the skull and seem to overhang the blowholes but slightly, although this relation is somewhat obscured owing to a slight injury. The maxillary bones *slope downward* from their junction with the premaxillæ to the rim of the cranium. In the Long Branch cranium, which is that of an animal fully adult, the broad proximal portions of the premaxillæ are slightly hollowed in front of the nares, and rising to the summit of the skull, overhang the blowhole by their greatly thickened antero-dorsal edges. In front and at the sides of the nares the maxillaries *are elevated* as much as 2.5 cm. above the adjacent premaxillaries, so that True's ('85, p. 586) statement in regard to Ziphius and Hyperoödon holds good also in some degree for Mesoplodon, namely, that "there appears to be a progressive excavation or absorption of the bones lying in the median line of the upper surface of the beak, accompanied by introvertion of the premaxillæ and a rounding off of the extremity of the beak."

In both the Annisquam and the Long Branch skulls the right premaxillary is slightly larger than the left and the right nasal opening is more convex in its exterior outline than the left. In both specimens the maxillary and the premaxillary foramina are on practically the same line with relation to the transverse axis of the skull, though in the Long Branch specimen the former is about 1 cm. behind the latter. In the Annisquam specimen the maxillary foramen is very large and its opening is below the level of the surrounding parts. It is continued forward as a deep groove or canal to the base of the rostrum, which is a feature practically lacking in the skull from Long Branch. In each ramus of the lower jaw there is a single tooth situated 25 cm. from the tip, or 3 cm. anterior to the middle point. From measurements given by Grieg ('98) for the two Karmö specimens the large tooth was situated at one third the jaw length from the tip in each. In the Cap Breton specimen, according to Fischer ('92) the tooth was three

sevenths of the jaw length from the tip, just back of the symphysis. The teeth of the Annisquam specimen barely projected above the alveoli of the jaws and are sharply mucronate. The basal portion of each, however, is more like that of the male's tooth in the slightly convex posterior outline and the forward extension of the anterior angle. Fig. 3 represents a lateral view of the tooth from the right mandible of the Annisquam whale; its extreme length from the point to the anterior tip is 55 cm.

The Annisquam skeleton has 45 vertebræ. Four of the seven cervicals are fused. The atlas, axis, and third cervical are firmly ankylosed throughout, save for the lateral foramina for the passage of the cervical nerves. The fourth cervical is fused to the third by the dorsal spine on the left side and by the tip of the upper lateral process of the same side. Its centrum, right half of the dorsal spine (the spine is divided medially), and the remaining lateral processes are free. This is the only case thus far recorded in which four cervicals have been found fused in this species for Reche's (:05, p. 171) statement that Flower has recorded a specimen the dorsal spine of whose fourth cervical was fused to the third, is a *lapsus*. Flower is here referring to *Ziphius cavirostris*. Grieg ('98) found that the first five cervicals were united in one of the Karmö specimens but the first two only in the other example and the same author (:04) found the first three fused in the Rugsund specimen (1901). Fischer ('92) records that in the Cap Breton whale the first two were entirely ankylosed while the centrum but not the spine of the third was fused with the second cervical. Aurivillius ('86) accredits the Bohuslän (1885) specimen with three fused cervicals. Turner ('85) found the first two only fused in the two Shetland examples and the same was true of these bones in the Skager Rack and the Vanholmen specimens (A. W. Malm, '71; A. H. Malm, '85). Van Beneden and Gervais in their *Ostéographie des Cétacés* give the number of

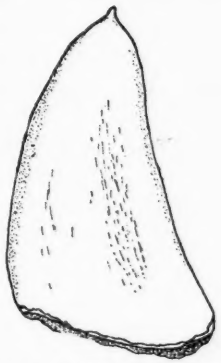

FIG. 3.— Lateral view of mandibular tooth of *Mesoplodon bidens*, female, Annisquam specimen. Natural size.

fused cervicals as three while both Van Beneden ('64) and Dumortier ('39) agree in stating that the first two only were fused in the Ostend 1835 example. The fusion of the first two is thus apparently the more usual condition. In the Annisquam whale the epiphyses of the fourth and fifth cervical vertebræ and the anterior epiphysis of the sixth cervical are fused to their respective centra, but all the other epiphyses of the vertebral column and of the pectoral limbs are free.

The Annisquam skeleton has nine dorsal vertebræ with their corresponding pairs of ribs, a number which agrees with that of at least four recorded skeletons though ten pairs of ribs are recorded in case of five others (Rugsund, 1901; Karmö, 1895; Shetland, 1885; Skager Rack, 1869; Ostend, 1835).

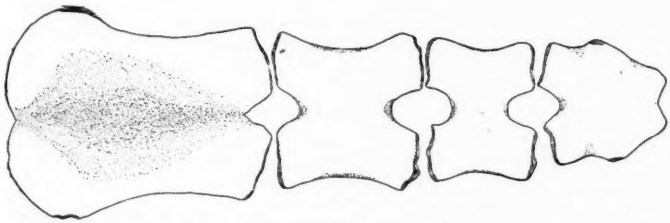

FIG. 4.—Sternum of *Mesoplodon bidens*, female, from above; Annisquam specimen.

The sternum of this specimen presents a few points of interest. It consists of four pieces, the anteriormost of which is largest, slightly hollowed above, and correspondingly convex below. The three remaining pieces are nearly flat, with a deep median notch at the anterior and posterior border of each. The most posterior piece evidently represents a fusion of the elements of two segments as there are articular surfaces for two pairs of ribs. Both the Karmö specimens (Grieg, '98) had sterna of four pieces and in each the fourth or most posterior piece seems to show articulating surfaces for two pairs of ribs. Apparently in these the very small sternal elements of each side corresponding to the fifth pair of ribs fused with the next anterior sternal segment but did not fuse medially with each other, so that a deep notch is left in the posterior margin of the last sternal piece. In the male Karmö specimen the notch is nearly closed posteriorly indicating a medial approxi-

mation of the elements of right and left sides, and thus approaches the condition described by Fischer ('92) for the Cap Breton specimen whose sternum was likewise of four pieces. The fourth was notched in front and had a central hole and a posterior notch. This central hole evidently corresponds to the two notches that would have been formed between the fourth and fifth sternal elements had they failed to fuse with each other. In the Annisquam specimen this space has been quite obliterated. According to A. W. Malm ('85) the sternum of the Skager Rack whale consisted of five pieces of which the two posterior were ankylosed, while that of the Vanholmen specimen was of four segments. Aurivillius ('86) states that the sternum of the Bohuslän skeleton was of four pieces of which the last is practically like the others save that the posterior notch is nearly closed. The sternum of the Rugsund specimen as figured by Grieg (:04, p. 33) is likewise of four segments, but the two elements of the fourth segment have not united medially while that of the left side is ossified with the next anterior piece. The 1885 Shetland whale had five sternal pieces (Turner, '85) but the 1881 Shetland example had four sternal pieces only, the posteriormost of which, as in the Annisquam skeleton, represented a fusion of the fourth and fifth pairs of elements (Turner, '82). Still another variation is seen in the Ostend specimen in which the two elements composing the fifth or posteriormost piece are separate both from the piece next anterior and from each other, while that of the left side is apparently displaced so as to be in advance of the corresponding element of the right side (Van Beneden, '64, pl. 3, fig. 2). An additional point of interest in the Annisquam sternum is its bilateral asymmetry for the right-hand element of each of the four pieces is slightly longer than that of the left side (Fig. 4). Thus the extreme lengths of the right-hand elements in centimeters are: 15.1; 8.4; 6.0, and 7.1, while those of the left-hand elements are 14.7, 7.9, 5.85, and 6.8 respectively. A like asymmetry is seen in Grieg's figure of the Rugsund specimen.

For convenience of reference, the known recorded specimens of Sowerby's whale are listed in the following table: —

Recorded Specimens of Mesoplodon bidens

No.	Sex	Locality	Date	Reference
1	male	Elginshire, Scotland	1800	Sowerby, '04
2	female	Havre, France	Sept. 9, 1825	Blainville, '25
3	male	Sallenelles, France	Summer, 1825	Deslongchamps, '66
4	female	Ostend, France	Aug. 21, 1835	Dumortier, '39
5	male	Brandon Bay, Ireland	Mar. 9, 1864	Andrews, '69
6[1]	male	Norway	before 1866	Van Beneden, '66
7	—	Nantucket, Mass.	1867	Agassiz, '68
8	male	Skager Rack	June 15, 1869	A. W. Malm, '71
9	male	Brandon Bay, Ireland	May 31, 1870	Andrews, '70
10	female	?Scotland	1872	Turner, '72; Flower, '72
11	female	Hevringholm Strand, Denmark	Feb. 3, 1880	Reinhardt, '80–'81
12	male	Shetland	Apr., 1881	Turner, '82
13	male	Vanholmen, Sweden	Oct. 30, 1881	A. H. Malm, '81, '85
14	male	Shetland	May 23, 1885	Turner, '85
15	male	Bohuslän, Sweden	Aug. 6, 1885	Aurivillius, '86
16	male	Yorkshire, England	Sept. 11, 1885	Southwell and Clarke, '86
17	male	Firth of Forth, Scotland	Oct., 1888	Turner, '89
18[2]	—	——	before 1888	Van Beneden, '88
19[3]	female	Norfolk, England	Dec. 18, 1892	Southwell and Harmer, '93
20	male	Cap Breton, France	Aug., 1888	Fischer, '92
21	female	Atlantic City, N. J.	Mar. 28, 1889	Turner, '89
22	female	Karmö, Norway	Aug. 25, 1895	Grieg, '98
23	male	Karmö, Norway	Aug. 29, 1895	Grieg, '98
24	female	Annisquam, Mass.	Aug., 1898	Hyatt, '99
25	male	Rugsund, Norway	Nov. 14, 1901	Grieg, :04, :05
26	female	North Long Branch, N. J.	July 22, 1905	

To this list should probably be added the record of a specimen found floating in the sea at the entrance of the British Channel about 1840. The skull of this whale is said to be in the museum at Caen (Flower, '78) and on it Gervais in 1850 founded his *Mesoplodon europæus*. Some confusion has also existed in regard to

[1]An incomplete lower jaw in the Museum at Christiania.
[2]An incomplete cranium without data in St. Petersburg Museum.
[3]Contained a large fetus.

the dates of certain of the captures. Thus Reinhardt ('80–'81) and Van Beneden ('88) have included examples of Hyperoödon in their lists of records; Gray ('66, p. 352) mentions a specimen from Havre, Aug. 22, 1828, and Van Beneden ('88, p. 98) apparently has quoted Gray in including this record in his paper on the Ziphioids of European waters. It is clear, however, from the context that Gray is referring to the specimen described by Dumortier ('39) and taken at Ostend, Aug. 21, 1835. Of this whale, Dumortier relates that it was kept alive out of water for the space of two days but could not be prevailed upon to eat the moistened bread that was offered it! Frequently it gave vent to loud bellowings that resembled the lowing of a cow. Grieg ('98) is able to confirm this testimony as to the possession of a voice by this species, for he states that the female stranded at Karmö in 1895, lowed like a calf that is being slaughtered.

It is clear, then, that *Mesoplodon bidens* is certainly known from the North Atlantic only, between the latitudes of 39° N. (Atlantic City, N. J.) and about 60° N. (Shetland). That it is probably not gregarious has been pointed out by previous writers, and its presence in the colder months at the northern part of its known range has been taken to indicate that it is not migratory, at least in so clear a manner as is the bottle-nosed whale (*Hyperoödon ampullatum*). The fact that so large a proportion of the stranded specimens has been taken on the coasts of islands is indicative of the pelagic habitat of this species as contrasted with certain of the porpoises that often frequent the shallower waters along the coasts.

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FRESH-WATER RHIZOPODS OF NANTUCKET

JOSEPH A. CUSHMAN

DURING the spring of 1905 collections were made from the bodies of fresh water on the island of Nantucket, Mass., by several members of the Nantucket Maria Mitchell Association. This material was turned over to me for examination. A portion of it was made up of the sediment squeezed from submerged sphagnum. This, as was to be expected, seemed to be the richest in Rhizopods and contained many more species and individuals than the material from the bottom of the larger ponds. Certain species seem to be very limited in their distribution on the island, often occurring in but one of the collections out of the fifty or more examined. In such cases, however, there was usually an abundance of specimens of the species in that one collection. Other forms which were to be expected here were not met with at all. Of these Hyalosphenia was the most striking genus, as it usually occurs in just such material. Nearly all of the species found were of small size for their respective species and may be compared with the specimens noted by the writer and Mr. Henderson from the alpine region of the White Mountains (*Amer. Nat.*, vol. 39, March, 1905, p. 155). The cause of this minimum size in the case of the Nantucket specimens is hard to explain unless for some reason there is not sufficient nourishment for them, but this does not seem to be a reasonable explanation since the ponds are well supplied with minute algæ, especially desmids and diatoms. For certain of the records I am indebted to Mr. W. P. Henderson. The following species were found: —

1. **Arcella vulgaris** Ehrenberg. Breadth 52–55 μ; height 21–23 μ; aperture 12–14 μ.

Common. Hummock and Gibb's Ponds and from bog moss.

2. **Arcella discoides** Ehrenberg. Breadth 46–75 μ; height 20–25 μ; aperture 8–19 μ.

Common, but of small size. Hummock and Sesacha Ponds and from sphagnum in different parts of the island.

3. **Centropyxis aculeata** Stein. Breadth 65–72 μ; height 30–38 μ; aperture 11.5–18 μ.

Of small size. Common in Hummock Pond and in sphagnum swamps.

4. **Centropyxis aculeata ecornis** Ehrenberg. Length 94 μ; breadth 78 μ; aperture 26 μ. From sphagnum.

5. **Quadrula symmetrica** Schul. Length 68 μ; breadth 38 μ; aperture 13.5 μ.

This species occurred but once and then in considerable numbers. It was from bog moss material near the town. The specimens were very uniform in size and were small.

6. **Difflugia globosa** Dujardin. Diameter 58–65 μ. Hummock Pond.

7. **Difflugia pyriformis** Perty. Length 90–102 μ; breadth 45–54 μ; aperture 21–24 μ.

Small. Common in Gibb's and Wigwam Ponds and in sphagnum.

8. **Difflugia acuminata** Ehrenberg. Length 125–168 μ; breadth 40–71 μ; aperture 12–27 μ.

Of small size. Wigwam Pond and from bog moss.

9. **Difflugia corona** Wallich. The only specimens referable to this species were from Wigwam Pond. These were of the usual shape but somewhat undersized and their shells instead of being composed of sand grains were almost entirely made up of diatom frustules. Diameter 112–132 μ; aperture 50 μ.

10. **Difflugia constricta** Ehrenberg. Length 60–87 μ; breadth 36–46 μ; aperture 18 μ. Specimens of this species were found in but one lot of material and in this they were common. They were from bog moss near the town. The specimens were all undersized.

11. **Difflugia lobostoma** Leidy. Length 84 μ; breadth 52 μ; aperture 13 μ. From sphagnum.

12. **Lecquereusia spiralis** Ehrenberg. Length 94 μ; breadth 68 μ; thickness 58 μ.

This species was found in material from the north head of Hummock Pond only. The shells were composed of the peculiar pellets characteristic of this species. The specimens were small for the species.

13. **Euglypha alveolata** Dujardin. Length 90 μ; breadth 75 μ; aperture 23 μ.

This species was met with but once, *viz.*, in material from Wig-

wam Pond. The specimens of this species differ from those of most of the others in being of at least medium size for the species.

14. **Euglypha ciliata** Ehrenberg. Length 44–65 μ; breadth, minimum 20–24 μ; maximum 25–40 μ; aperture, maximum 14.5 μ, minimum 10 μ.

This species may be called common. It was found in material from Hummock Pond and in various collections from bog moss. Unlike the preceding species of this genus the specimens as a rule were undersized.

15. **Assulina seminulum** Ehrenberg. Length 48 μ; breadth 38 μ; thickness 17 μ.

Specimens of this species were found in material from the south end of Hummock Pond. They were of small size.

16. **Heleopera sphagni** Leidy. Length 145 μ; breadth, maximum 100 μ, minimum 48 μ.

This species was found only once but in that material it was common. It was from sphagnum near the north end of Hummock Pond. In size the specimens as a rule were above the average for the species, but were comparatively thin.

17. **Heleopera petricola** Leidy. Length 102 μ; breadth 60 μ; aperture 39 μ. From sphagnum.

18. **Nebela collaris** Ehrenberg. Length 81–150 μ; breadth 58–76 μ; aperture 16–23 μ. From sphagnum.

19. **Nebela caudata** Leidy. A single specimen of this rare species was obtained from sphagnum.

20. **Cyphoderia ampulla** Ehrenberg. Length 110–112 μ; breadth 38–46 μ; aperture 10–12 μ.

In a collection from bog moss near the town this species was abundant, but was not met with elsewhere on the island. The specimens were of very uniform size and small for the species.

21. **Trinema enchelys** Ehrenberg. Length 29–70 μ; breadth 12–34 μ; aperture 4–13 μ. From sphagnum.

22. **Acanthocystis spinifera** Greef. Diameter with spines 75 μ.

Specimens which seemed to be this species were found in material from Reedy Pond. They closely approximate the figures of a species of this genus figured by Leidy without a specific name.

NOTES AND LITERATURE

ZOÖLOGY

Weismann's Theory of Descent.[1] — "When a life of pleasant labor is drawing towards a close the wish naturally asserts itself to gather together the main results, and to combine them in a well-defined and harmonious picture which may be left as a legacy to succeeding generations." Thus does the genial author set forth the aim and motive of his book. And no biologist can fail to be grateful for the publication of these charmingly readable lectures, presenting in two ample volumes the best thoughts of a clear and vigorous thinker. The translation into English has been admirably done.

The early chapters set forth once again the data of evolution and the most striking examples of adaptation, for many of which, in the reviewer's opinion, no other explanation so satisfactory as that of natural selection has ever been offered, and which consequently justify the further elaboration of the theory to which the book is devoted. Four more chapters present the facts of germ cells and fertilization and then the germ-plasm theory is elucidated; criticisms directed against it are answered; various accessory theories, particularly that of intragerminal selection are set forth; and finally its relation to the formation of species is fully discussed.

It is impossible in the space of a brief review to set forth Weismann's standpoint; it is unnecessary, also, for it is already well known to most naturalists. A few words may, notwithstanding, be devoted to his most recent accessory hypothesis upon which he lays the greatest possible stress, that of Germinal Selection. In attempting to explain the gradual disappearance of organs he first hit upon the hypothesis of panmixia but, however satisfactory as a factor of incipient deterioration, it became clear that panmixia could not account for complete elimination. The necessary hypothesis was found in a struggle among the organ-determining germinal particles — the determinants — due to the limitations of nutrition supplied to the germ cells. The

[1] Weismann, A. *The Evolution Theory.* Translated with the author's coöperation by J. A. & Margaret R. Thomson. London, E. Arnold, 1904. 8vo, 2 vols., xvi + 416 and 405 pp.

weaker determinants get less food, grow less well, and consequently become in turn still less capable of nutrition. Once started on the downward path the determinant descends more and more until it is wholly eliminated. Nothing can save the determinant from this fate except the elimination by natural selection of the adults of the strain possessing the deteriorating determinant — and this will only happen when the degenerating organ again becomes necessary to the welfare of the postembryonic organism.

Not only the degeneration but also the upbuilding of an organ can be explained by the hypothesis of germinal selection. For a certain strong determinant once having been selected, it will gather to itself all available nutrition at the expense of the other determinants; it will flourish in the race and will only stop its continual accretions when it produces organs so developed as to be disadvantageous to the active organism.

In criticising this hypothesis one can only admit that it explains so many facts that we hope it will some day be demonstrated. As it is, it stands to-day a bald hypothesis based on numerous probable but unproven assumptions.

Coming now to Weismann's position on the origin of the specific type we find it of interest as being clearly opposed to that of de Vries. Both theories accept the idea of unit characteristics which are represented in the germ by particles. The theories begin to diverge in respect to these particles. De Vries concludes that these particles change suddenly, probably by molecular changes within them, so that a new characteristic arises suddenly and tends thereafter to persist. The characteristic may be modified by selection, but its essential nature cannot be changed thereby. Weismann on the contrary regards these particles as being in a constant state of variation which, when continued long in one direction, will result in the elimination of a character or in its excessive development. Species are originally connected by transition forms as are to-day the terrestrial snails of the Celebes (page 299). Weismann repeatedly emphasizes the idea that all variations are quantitative and that "what appears to us a qualitative variation is, in reality, nothing more than a greater or less" (vol. 2, p. 151). Here then we have clearly set forth the issue between de Vries and Weismann: one maintains that variations of phylogenetic significance are always qualitative; the other, that they are quantitative only. This difference between the two schools would seem to be a qualitative one. But alas for the peace of mind of him who seeks clear distinctions, the quantitative may produce the qualita-

tive, as Weismann points out (vol. 2, p. 152)! He says, a cell changes its *constitution* (*i. e.* undergoes a qualitative change) when "the proportion of the component part and chemical combinations" is disturbed, "when, for instance, the red pigment-granules which were formerly present but scarcely visible increase so that the cell looks red. If there had been no red granules present, they might have arisen through the breaking up of certain other particles — of protoplasm, for instance, in the course of metabolism, so that, among other substances, red granules of uric acid or some other red stuff were produced. In this case also the qualitative change would depend on an increase or decrease of certain simpler molecules and atoms constituting the protoplasm molecule." The foregoing quotation sets forth clearly Weismann's conception of the way in which a wholly new character may arise and I imagine that de Vries would accept the hypothesis. They would differ only as to whether there was at first a great chemical change or a slight one increasing with successive generations. Thus the essential difference between de Vries and Weismann shows itself to be one of degree only.

C. B. D.

The Oyster.[1] — A very fascinating book presenting in a thoroughly scientific, yet in a readable and popular style the complete development and anatomy of the oyster, the possibilities of oyster culture, the cause of the decline in our oyster industry, and the remedy.

One can hardly realize that since statistics have been kept (1865), there have been taken from the Chesapeake Bay, upwards of four hundred million bushels of oysters. "This inconceivably vast amount of delicate, nutritious food has been yielded by our waters without any aid from man. It is a harvest that no man has sown; a gift from bounteous nature."

This great productiveness shows how favorable this body of water is for the oyster, and what might be done under judicial management and culture. It is doubtful if the present areas of oyster beds (about two hundred square miles) can ever regain their former prestige even if they could be utilized to the best advantage by culture. The demand has continued and will continue to outgrow the supply. The area occupied by the natural beds, however, covers but a small por-

[1] Brooks, William K. *The Oyster. A Popular Summary of a Scientific Study.* Second and revised edition, with introductions by Daniel C. Gilman and Ira Ramsen. Baltimore, Johns Hopkins Press, 1905. 12mo, 225 pp., illus.

tion of the bottom suitable for oyster-farming, "and it is safe to estimate the total area of valuable oyster-ground in our state at one thousand square miles." If this vast area could be properly developed, there should be a good supply for years to come. The author points out clearly what should be done, and we trust he will have the coöperation of every intelligent man in saving and redeeming this great industry.

C. W. J.

Sea-shore Life.[1]—Dr. Mayer has presented to the public a popular work which, while not without merit, shows a carelessness in arrangement and constant misstatement of facts which we hardly expect in these days when accuracy and precision of classification are considered of paramount importance.

The book presents a truly attractive appearance, and the figures with few exceptions are new and really valuable. The closing table of references seems well chosen.

The text, however, is the part which gives most evident signs of hasty preparation. The sections dealing with "Jellyfishes and Hydroids" and with "Sea Anemones and Corals" reveal no startling peculiarities, nor, except for rather unimportant details, do the following sections until we arrive at that entitled "The Crustaceans." Here the arrangement is startling indeed. Under the subheading "The Barnacles," the following genera are discussed and figured: Balanus, Coronula, Lepas, *Homarus*, *Palinurus*, and *Alpheus*. "The Crayfishes" follow in a perfectly rational manner. Next come "Shrimps and Prawns." On page 89 we read: "Shrimps are known to science as the Schizopoda!" And now these following genera, presumably Schizopods are discussed Crangon, Palæmonetes, Penæus, Stenopus, and last but by no means the least in this connection, Mysis. Among the "Hermit Crabs" we find Hippa and Squilla. On page 107, Geocarcinus occurs among the "Fiddler Crabs," and under this same main heading the spider crabs and Limulus. Among the molluscs under the heading "The Fresh-water Mussels," we find Pecten, Anomia, and Meleagrina.

We must not, however, presume to be hypercritical. For all its peculiarities this book will probably amuse as many as it leads away from the devious paths of correct scientific classification.

T. B.

[1]Mayer, A. G. *Sea-shore Life. The Invertebrates of the New York Coast.* New York Aquarium Series, No. 1. Published by the New York Zoölogical Society, 1905. 8vo, 181 pp., 119 figs.

Alder and Hancock's British Tunicata.[1]—At last, thirty-eight years after the death of one of the authors (Alder), and thirty-two years after the death of the other, this work on British Ascidians, long known by students of the group to be hidden away somewhere in manuscript, has emerged to the light of day in a well printed volume of 146 pages and 20 plates, dressed in the familiar costume of the Ray Society's publications.

The historical statement by Canon Norman, a personal friend, if I mistake not, of both authors, gives briefly the vicissitudes through which the work has passed both before and since the authors laid it aside for the last time. There is something rather melancholy in a story like this. Pity it is, first having regard for these worthy naturalists themselves, that the fruits of their labors might not have long ago reached the hands of other students of these animals. Thus would a field of knowledge have been enriched, and deserving men could have received the recompense of acknowledgment richly their due, which by this delay has been largely denied them. And the somberness of the picture will be increased a little for many naturalists by the query, with some undoubtedly made more real by personal experiences, as to how far works of their own hands may have a similar fate in store for them.

One of the serious difficulties that has always been encountered by proposals to publish this monograph, Mr. Norman tells, has been the illustrations. A great number of these was left particularly by Mr. Hancock. Of these many were in various stages of elaboration, so that the two-fold problem of what to do with unfinished drawings, and of providing funds for reproducing the large number that was finished had to be met. But little use has been made, we are given to understand, of the unfinished figures. Even so, about 140 are published in the plates, 75 of which are colored; and there are 23 text figures. There can be little doubt that the illustrations will constitute one of the chief values of the work. Most of them are admirably drawn, and the reproduction is in the main good. The habitus figures should be specially useful as a seaside aid to identifying the species.

A historical sketch of the knowledge of the group introduces the work proper. This would have been of high value had it been published long ago; but with the recent extensive studies on the literature by Herdman and Seeleger, this portion of the monograph is made to a considerable extent antiquated.

[1] Alder, J., and Hancock, A. *The British Tunicates.* Vol. I. London, published by the Ray Society, 1905. 8vo, 146 pp., 20 pls.

Hancock's well known paper "On the Anatomy and Physiology of the Tunicata," originally published in the *Journal of the Linnean Society*, 1867, is appropriately reprinted here.

Naturally and very wisely, Mr. Hopkinson has refrained from any revisions of the text beyond what was absolutely necessary to rectify obvious typographic errors. It results from this that in several particulars both as to interpretation of structure, and classification, there is want of conformity to views now held. The most striking thing in this regard is the contention for the molluscan affinities of the tunicates. (The only discussion, however, of this question is that contained in Mr. Hancock's memoir above referred to.) The arguments put forward in support of this view are decidedly interesting reading from a historical point of view, and from the standpoint of now approved criteria of homology. It is surprising that Hancock should have failed even so much as to mention the theory of the vertebrate relationships of the group. One must suppose that at the time of writing this memoir the author had not yet become acquainted with Kowalevsky's important paper on embryology, published the year before. The only clue given us as to what either author's later views were on this fundamental matter, is found in the reference to a paper by Hancock, published in 1870, "On the Larval State of Molgula" etc. Here the author concluded that since there are two distinct modes of development in closely allied genera of the Tunicata, the tadpole condition is non-essential; and he expressed the belief that this fact would influence the theory of the vertebrate relationship of the group.

This volume treats only of the genus Ascidia, in the systematic part, as the genus was then understood. Thirty species are regarded as "good," and five varieties are recognized.

Although the volume is numbered *one*, I see no indication that another is to follow.

It is certainly well that this work is now published, but as certainly it would have been much better could it have been done long years ago.

W. E. R.

Schillings's With Flash-light and Rifle.[1]—The rapidity with which the larger mammals of Africa are becoming exterminated makes it

[1] Schillings, C. G. *With Flash-light and Rifle. Photographing by Flash-light at Night the Wild Animal World of Equatorial Africa.* Translated and abridged by Henry Zick, Ph. D. New York, Harper Brothers, 1905. 8vo, xiii + 421 pp., illus.

imperative that no time be lost in procuring specimens for study and in investigating their habits. Schillings, a German hunter-naturalist, is one of several explorers who in recent years have made expeditions into the Dark Continent and have brought back valuable collections of its rich fauna.

Four expeditions were made into German East Africa by Schillings, and a large number of carefully prepared specimens of the more important game mammals were secured and brought to Berlin for the imperial museum. Several new species have been described from this material (mainly by Matschie) and many others have been forms that are very rare in collections. The present work is mainly an account of the experiences of Herr Schillings during these four journeys into the African wilderness, and is translated and abridged by Henry Zick from the original *Mit Blitzlicht und Büchse* (1905).

The chief feature of the book is the large number of photographs of these animals in their natural surroundings, taken by the author during his three last expeditions. Many of these pictures are remarkable and extremely valuable, taken at night by flashlight as the animals came to the water-holes to drink. Other views were obtained by means of a telephoto lens and illustrate a number of the antelopes and other day-feeding species. Those of the giraffe, the zebra, the lion, and the leopard are particularly noteworthy. Many of the photographs, however, are altogether too indistinct to be of any value, though from an impressionist's standpoint they may pass as pictures. These less satisfactory views have been largely omitted from the English edition, however.

While the photographs are the main feature of the book and by themselves are of permanent value, the narrative is also of interest as a popular treatise on the habits of the species dealt with. A number of notes on the larger mammals are recorded in the course of the narrative, such as the blending of the black and white striped zebras with "the colors of the steppe, so that they are hard to distinguish even at close range" and "under certain lights they appear grayish." That lions at certain times of the year may be found in "troops" of as many as seventeen the author has had personal proof. It is also true that the lynxes of our own country may at times be found in packs although a recent nature writer has dogmatically denied this. The versatility of the long-necked Waller gazelle is shown in its habit of standing on its hind legs, after the manner of goats, in order to increase the vertical extent of its feeding range. In addition to chapters on the rhinoceroses, the elephant, the lion, the giraffe, the zebra, antelopes, and the smaller

carnivores, the latter part of the book deals particularly with the inhabitants of the country and the difficulties that confront the explorer.

The translation is in the main good, though marred here and there by a grammatical error and by a certain looseness of expression, as where scorpions are termed "reptiles," and hippopotami are familiarly spoken of as "river hogs"; the use of capitals for the authority of Latin names seems also to have afforded a stumbling block. An index might have added to the usefulness of the book.

G. M. A.

Notes.— *Recent Extension of the Range of the Green Crab.* About the year 1892 or 1893, I first began to notice at Cohasset, Mass., an occasional specimen of a green crab. These crabs were about two inches in diameter and were seen at low tide on the mud flats about our float in company with *Cancer irrorata.* From that time on I noticed a gradual increase in their numbers but thought nothing of it until 1902, when a reference to a "green crab" in a physiology lecture made me wonder if the crab which had recently become so abundant at Cohasset was the same as that experimented upon. On submitting specimens to Dr. Walter Faxon for determination, I learned that they were *Carcinides mœnas,* a species that was not believed to occur north of Cape Cod. In the course of the summer I collected specimens at the following additional localities: Nahant, Lynn, and Ipswich, Mass., and Kittery, Maine. In the same year (1902) it was collected at Manomet Point, Mass., by Mr. J. A. Cushman, and a record of its occurrence at Portland, Maine, was obtained by Dr. Faxon. Miss Mary J. Rathbun in her "List of New England Crustacea," gives the following additional localities in Maine: Harpswell; New Meadows River, near Harpswell; and Eagle Harbor, Casco Bay; all, I believe, based on records obtained shortly previous to 1904.

The next spring, 1904, I determined to find out just how far to the eastward the green crab had reached, but gave up the undertaking after several attempts to procure specimens from Cohasset had proved unsuccessful and after hearing from Kittery that there were practically none to be found there. The winter of 1903–04 had been unusually severe along the shore and the ice consequently very thick. It had scraped every bit of eel grass from off the mud flat at the edge of which the year before I had been able to find an abundance of green crabs and it had probably killed off the crabs along with the eel grass. During the summer I made careful search for more specimens of Carcinides at every locality where I collected and especially at Cohas-

set, but did not find so much as a dead carapace. Mr. Cushman, however, after considerable hunting, managed to secure a few living specimens at Manomet Point. Farther north they seem to have been for the time exterminated.

It is unfortunate that accurate dates cannot be given for the first appearance of this crab at the various stations where it has been taken north of Cape Cod. All the data I can offer on this point are: (1) my impression that they first appeared at Cohasset about 1893; (2) the statement of Mr. Stephen Decatur that he began to notice them at Kittery, Maine, at about the same time; (3) the negative evidence that the species is not included in Professor Kingsley's "Invertebrata of Casco Bay" published in 1901; and (4) the fact that my uncle, Dr. W. S. Bryant, who did considerable collecting and dredging at Cohasset about twenty years ago, had never seen them there.

From these data it appears that the extension of the green crab's range from Cape Cod to at least as far north as Kittery, Maine, occurred very rapidly; that it worked its way slowly along the shore from the neighborhood of Kittery; and that it is not yet permanently established north of Cape Cod.

At Cohasset this last summer, 1905, I found a few dead immature specimens washed up, and on November 19, 1905, Mr. T. Barbour and I collected several living specimens, some nearly full grown, in tide pools on one of the other reefs. There is hope, therefore, that it may again, after a few favorable seasons, become common north of Cape Cod.

The green crab is found in tide pools, along the edge of mud flats, on beaches, and under overhanging rockweed. It does not seem to burrow in sand or mud as does Cancer, when it is left by the tide. It is therefore easily detected and its presence or absence should be noted by everyone who has the opportunity to observe the fauna of our northern New England coast.

OWEN BRYANT

The Pelvic Region of the Porpoise. Because of the degeneration of the pelvic girdle in the porpoises and other cetaceans, it has been impossible on purely osteological grounds to state with precision which vertebræ in these animals correspond to the sacral vertebræ of other mammals. Knauft (*Jen. Zeitschr. f. Naturw.*, vol. 40, pp. 253–318) has attacked this problem from the standpoint of the spinal nerves and has shown that the vertebral column is so related to the lumbo-sacral plexus in the porpoise that instead of possessing 14 lumbar vertebræ as has been generally assumed, this animal has

only 6 and that consequently its sacral vertebræ are much more anterior in position than has heretofore been supposed.

G. H. P.

Adaptations in the Arteries of the Horse. Bärner (*Jen. Zeitschr. f. Naturw.*, vol. 40, pp. 319–382) in a study of the thoracic and abdominal arteries of the horse has shown that the structure of the arteries varies with the blood pressure, the mechanical relations to the surroundings, and the functional relations of the vessels. As the blood pressure decreases in the more distant vessels the arterial walls become thinner and take on more the character of muscular tubes. Where arteries receive support from surrounding parts, as for instance where the aorta pierces the diaphragm, their walls are thin. Finally adaptations are to be seen where special conditions exist; thus the vertebral artery has its elastic elements unusually developed in relation to a demand for the utmost freedom of movement in the horse's neck.

G. H. P.

Two New Chipmunks. Dr. C. H. Merriam (*Proc. Biol. Soc. Wash.*, June, 1905) describes two new chipmunks of unusual interest. One of them, called *Eutamias amœnus operarius*, is the common little four-striped species of the Boreal zone in Colorado. It has been referred to Say's *E. quadrivittatus*, but that species lives in the foothills, and the mountain form is actually nearest to *E. amœnus* of the Californian Sierras. In view of the widely severed habitats of the forms *operarius* and *amœnus*, and the absence of any evidence of intergradation, it would seem that the Colorado animal should rather rank as a full species, *Eutamias operarius*. The other new chipmunk is *E. hopiensis*, an unusually handsome form from the Painted Desert, Arizona.

T. D. A. C.

The Ant Genus Liometopum. Dr. W. M. Wheeler (*Bull. Amer. Mus. Nat. Hist.*, Nov., 1905), gives an interesting revision of the genus Liometopum, as found in North America, with a discussion of the habits of the species. The geographical distribution of Liometopum is of especial interest, as it is one of those types which may be designated palæoboreal; that is to say, it appears to have had a boreal distribution in times past, but has now been driven south, where it persists, with few representatives, in the southern parts of the temperate zones of both hemispheres. Herein it reminds one somewhat of the butterfly genus Parnassius, but it differs from that in the smaller

number of species, and the much less alpine habitat. The species are three, so far as known: *L. microcephalum* of southern Europe, *L. lindgreeni* of Assam and Burma, and *L. apiculatum* (with varieties or subspecies *occidentale* and *luctuosum*) of western North America. In New Mexico *L. apiculatum* ascends to about 8000 ft., and in Mexico even somewhat higher. T. D. A. C.

Ichthyological Notes.— In the *Memoirs of the New South Wales Naturalists' Club*, (no. 2, 1904), Mr. Edgar R. Waite gives a most useful catalogue of the fishes of that State, with reference to the descriptions of each species. Mr. Waite has adopted a modern sequence in his classification and the names adopted by him show a praiseworthy attention to the necessary rules of nomenclature. Five hundred and twenty-six species are enumerated, most of them occurring in the harbor of Sydney.

In the *Records of the Australian Museum*, 1904, vol. 5, Mr. Waite has a useful review of the gobies with separate ventrals, known as Eleotrids, found in the waters of New South Wales. In another paper in the same *Records*, Mr. Waite discusses the breeding habits of the Fighting Fish, *Belta pugnax*.

In the *Transactions of the New Zealand Institute*, Professor W. B. Benham of Otago University describes a new species of the great pelagic Oar-fish, under the name of *Regalecus parkeri*.

In the *Meddelelser fra Kommissionen for Havundersögelser*, of Denmark (vol. 2, no. 7, 1905), Dr. Adolph Severin Jensen gives a monographic account of the ear-stones of fishes dredged in the "Polar Deep." He develops the fact, hitherto unknown, that otoliths in great quantities are deposited in the northern seas at the present time. Many of these belong to the small codfish, *Micromesistius poutassou*, a fish not properly reckoned as arctic.

In the *Bulletin of the Bureau of Fisheries for 1904* (vol. 24) Mr. Frederick A. Lucas discusses the osteology of the Tile-fish, *Lopholatilus chamæleonticeps*, a singular fish of the depths of the Atlantic. He finds the family Latilidæ, to which it belongs, well defined, and well separated from Malacanthus and from Bathymaster, which have been wrongly associated with it. In the same *Bulletin*, Mr. C. E. Silvester discusses the blood-vascular system of the Tile-fish.

In an elaborate paper in the *Proceedings of the Washington Academy of Sciences*, William F. Allen, of Stanford University, describes

in great detail the circulatory system in the fishes with mailed cheeks, or Loricati. Among other things he shows that the Ophiodontidæ and the Zaniolepidæ, should be separated, as dis inct families, from the Hexagrammidæ.

In the *Memoirs of the New York Academy of Science*, (vol. 2, 1905), William E. Kellicott gives an elaborate and useful account of the development of the vascular and respiratory systems of the dipneustan genus, Neoceratodus. He calls this genus by the same name as its extinct ancestor or predecessor, Ceratodus.

In the *Bulletin of the Illinois State Laboratory of Natural History*, Dr. S. A. Forbes and R. E. Richardson describe a new Shovel-nosed Sturgeon from Illinois River, under the name of *Parascaphirhynchus albus*. This species is found mixed with the ordinary Shovel-nose, *Scaphirhynchus platorhynchus* in the proportion of about one to five hundred. The new genus has the belly and breast naked, the ribs twenty or twenty-one. In Scaphirhynchus, the belly is mailed, the ribs ten or eleven only.

In the *Bulletin of the United States Bureau of Fisheries for 1904*, Mr. Chancey Juday, of the University of Colorado, records the species of fishes in Boulder Creek, twenty-five in number, one of them, *Leuciscus evermanni*, being new to science.

In the same *Bulletin* (vol. 24, 1904) Professor Kakichi Mitsukuri of the Imperial University of Tokyo, discusses the domestication or breeding of various fishes, turtles, clams, etc., in Japan. His account of the aberrant forms of the gold-fish, *Carassius auratus*, is especially interesting. About thirty monstrous forms are figured.

In the same *Bulletin* (vol. 24, 1904) Dr. D. S. Jordan and Surgeon J. C. Thompson give an account of the fishes taken by the latter while stationed at the Tortugas in Florida. Two hundred and eighteen species are enumerated, several of them not previously taken in the waters of the United States. New species are: *Holocentrus tortugæ*, *Eviota personata*, *Gnathypops aurifrons*, and *Execestides egregius*, the latter a new genus of Uranoscopidæ. A new genus, Etelides is based on the fish called *Anthias aquilionaris*. It differs from Etelis in the naked jaws, and the union of the two dorsal fins.

In a volume on *The Bahama Islands*, by Dr. George B. Shattuck (Baltimore, 1905), Mr. Barton A. Bean contributes an annotated list of the fishes known, with a number of excellent colored plates, the work of Mr. A. H Baldwin.

In the *Report of the Commissioner of Fisheries for 1904*, Professor John O. Snyder, of Stanford University, discusses the distribution of river fishes about San Francisco Bay. He shows also that *Leuciscus caurinus* of Richardson is a true Leuciscus, and a species distinct from *Mylocheilus lateralis*, hitherto supposed to be the same. *Ptychocheilus grandis* of the Sacramento is also, as Agassiz supposed, distinct from *P. oregonensis*, of the Columbia.

Mr. T. Kitahara (*Annot. Zoöl. Jap., for 1904*) of the Japanese Bureau of Fisheries corrects the nomenclature of some of the trout and salmon of Japan, as given by Jordan and Snyder in 1902. He shows that the "Ito" should stand as *Hucho perryi*, and the "Masu," as *Salmo masou*. The "Iwana," *Salvelinus pluvius*, he regards as identical with *Salvelinus malma*.

Jordan (in the same *Annotationes*, and in the *Proc. U. S. Nat. Mus.*, vol. 27) reviews Mr. Kitahara's paper, recognizing the following species of Salmonidæ in Japan:—

Oncorhynchus nerka (Walbaum); Beni-masu.
Oncorhynchus milkschitch (Walbaum); Gin-masu.
Oncorhynchus keta (Walbaum); Shake or Sake.
Oncorhynchus gorbuscha (Walbaum); Karafuto-masu.
Salmo masou (Brevoort); Masu, Ame-no-uwo, Yamabe.
Hucho perryi (Brevoort); Ito.
Salvelinus malma (Walbaum); Iwana, Ame-masu.
Salvelinus kundscha (Walbaum).
Plecoglossus altivelis (Schlegel); Ayu.

The king salmon, *Oncorhynchus tschawytscha* (Walbaum), has been since recorded from the northern part of Hokkaido, in a letter from Mr. Kitahara. Mr. Kitahara also notes the capture of *Salmo rivularis*, the California Steelhead Trout, (wrongly called *Salmo gairdneri*), off the northern part of the main island of Hondo. These two species should be added to the Japanese list.

The most elaborate faunal monograph yet published by the Bureau of Fisheries, and one of the most beautifully illustrated volumes in existence is the report of Jordan and Evermann on the fishes of Hawaii, published as part of the *Bulletin* of the United States Fish Commission for 1903, the last bulletin issued before the change of the name of the Commission to that of the Bureau of Fisheries.

In this volume are described in full four hundred and thirty-nine species of Hawaiian shore fishes, nearly all of which are admirably figured. Especially noteworthy are the seventy-three colored plates

taken from life in Honolulu and Hilo. Most of these are the work of C. B. Hudson and A. H. Baldwin. Captain Hudson's paintings, made in oil, from living fishes in the aquarium, here perfectly reproduced, constitute beyond question, the finest series of fish portraits ever made by any artist. The wonderfully rich fish fauna of the Hawaiian Islands is now one of the best known in the world.

This fauna is frankly and entirely tropical and almost all the species belong to genera found in the South Seas. The species are, however, in large part different. Of the four hundred and thirty-nine species recognized, two hundred and thirty-two are confined, so far as known, to Hawaii; one hundred and forty-two are found also in Samoa and Fiji; fifty-three are common to Hawaii and Japan, and thirty-four to Hawaii and the offshores of Mexico. The singular isolation of Hawaii, which, so far as fishes are concerned, has no parallel among other tropical island groups, may be due in part to the directions of the ocean currents. These currents seem to play a large part in the transportation of species, by floating young fishes from place to place.

The collections on which this volume is based have been made by the authors, by Oliver P. Jenkins, the first to collect on a large scale in Hawaii, by Charles H. Gilbert, John O. Snyder, Walter K. Fisher, Charles C. Nutting, Michitaro Sindo, and others.

Part 2, of the same *Bulletin*, issued as a separate volume, contains an account of the fishes taken about Hawaii in the deep-sea work of the *Albatross*. This volume is by Dr. Charles H. Gilbert, who was naturalist in charge on the *Albatross* in 1902.

About eighty species were obtained in the deep seas. Nearly all of them are new, an addition to our knowledge of fishes with few parallels in the records of deep-sea dredging. Many new genera are included, and a considerable number of the offshore genera of Japan have their range extended to Hawaii. Among these are Pegasus, Aracana, Gadomus, Hoplichthys, Melanobranchus, Lophiomus, Calliurichthys, and Polymixia.

This volume is to be commended for the careful accuracy of the descriptions and for the excellence of the plates.

The Philosophical Institute of Canterbury in New Zealand publishes an index to the New Zealand Fauna by Captain F. W. Hutton. In this volume is a list of the species of fishes known — without synonyms or references, the nomenclature being apparently carefully considered.

In the *Proceedings of the Academy of Natural Sciences at Philadelphia* (1905) Henry W. Fowler publishes a number of papers on rare or little known species of fishes in the museum of the Academy. One of these treats of fishes of Borneo, with a number of new genera and species; another of Arctic fishes, from Port Barrow; another, in connection with Dr. Benjamin Sharp, on the fishes of Nantucket. Two others treat of rare or little known forms allied to the Mackerel. A new subgenus, Sierra, is proposed for *Scomberomorus cavalla*; another, Lepturacanthus, for *Trichiurus savala*. *Caranx ruber* becomes the type of Elaphrotoxon and Vexillicaranx is typified by *Caranx africanus*. Rhapiolepis is based on *Scomberoides tol*. The Pilot-fish of the Pacific, found in Hawaii and Japan is described as *Naucrates polysarcus*, the type being from the West Coast of Mexico. If the species is valid, some one of the older names, given to Pacific specimens may belong to it.

In the *Proceedings of the United States National Museum* (vol. 28), Dr. Theodore Gill has a number of short papers on new points in ichthyology. *Prionotus stearnsi*, a smooth-headed gurnard from Florida, is the type of a new genus, Colotrigla. The insertion of the pectoral fins furnishes the chief distinctive peculiarity. Simopias is a new name proposed as a substitute for Pelor, preoccupied, and Rhinopias is proposed as the generic name for the singular *Scorpæna frondosa* of Martinique. The subfamily Pelorinæ becomes Inimicinæ, for the genus Inimicus. *Neosebastes entaxis*, a Japanese fish, is properly removed from Neosebastes to become the type of Sebastosemus Gill.

In the *Report of the United States Commissioner of Fisheries*, Dr. Gill gives an interesting historic review of the ichthyology of Massachusetts. Attention is called especially to the number of waifs, young fish from the tropics, found each year, where the Gulf Stream reaches the coast of Massachusetts.

In the *Proceedings of the United States National Museum* (vol. 28, 1905), Messrs. Jordan and Seale discuss the collection of fishes brought by Professor Bashford Dean from the island of Negros in the Philippines. One hundred and eighteen species, mostly small fishes from the coral reefs, were obtained, of which eighteen are new to science. The fish fauna of the Philippines is essentially that of the East Indies, with a dash of forms from the shores of Hindostan.

In the same *Proceedings*, Dr. Peter Schmidt of St. Petersburg discusses the huge Japanese Snail-fish, *Trismegistus owstoni*, and con-

cludes that its peculiar prickles do not justify generic separation from Liparis.

In the *Smithsonian Miscellaneous Collections* (vol. 45, 1904), *Hemibarbus joiteni*, a large chub from China, is described by Jordan and Starks.

In the *Proceedings of the United States National Museum*, (vol. 28, 1905), Dr. C. H. Gilbert and Surgeon J. C. Thompson discuss certain rare fishes collected by Dr. Thompson in Puget Sound. Two new species, both sculpins, are described: *Stelgidonotus latifrons*, and *Malacocottus kincaidi*, the first a type of a new genus. *Artedius asperulus* Starks proves to be the young of *Astrolytes fenestralis*.

In the same *Proceedings*, Messrs. Jordan and Starks discuss the fishes collected by Pierre L. Jouy on the coasts of Korea. Seventy-one species were obtained, a considerable number of which are new to science. The shore fishes are essentially those of Japan; the river fishes are nearly all new to science and of Chinese types.

In the *Annotationes Zoölogicæ Japonenses*, (vol. 5, 1905), Hans Sauter of Yokohoma describes a new fish from Japan, of the family Ateleopodidæ, under the name of *Ijimaia döfleini*. The genus Ijimaia differs from Ateleopus in the rather slight character of the shortened ventrals, and in the position of the mouth.

In the *Sitzungsbericht der Gesellschaft der naturforschender Freunde*, 1905, Mr. P. Pappenheim discusses the genera of Sturgeons, referring the Asiatic species of shovel nose, (Kessleria=Pseudoscaphirhyncus,) back to the American genus Scaphirhynchus. There is no obvious justification for this arrangement.

A. C. MacGilchrist (*Ann. Mag. Nat. Hist.*, ser. 7, vol. 15, 1905), describes a new genus, Dysalotus, (*D. alcocki*), allied to Chiasmodon, from South Africa.

Other short papers in the same *Annals* are by Mr. C. T. Regan, of the British Museum. From Tequesixtlan, Mexico, is described a new goby, *Cotylopus punctatus*. *Pseudoxiphophorus pauciradiatus* is held to be a valid species and a new "variety," whatever that may mean, is recorded from San Domingo de Guzman as *Pseudoxiphophorus bimaculatus* var. *tæniatus*.

Another paper deals with the genera of Asiatic catfishes, Parexostoma, Chimarrhichthys, and Exostoma. Still another describes two new fishes from the Inland Sea of Japan, unfortunately without indication of exact locality, and a new minnow from Lake Biwa.

In another paper, Mr. Regan defends his treatment of the genus Arges against strictures made by Messrs. Evermann and Kendall.

Useful revisions of certain South American genera of Cichlidæ are also given by Mr. Regan. It is not clear that any useful purpose is served by changing the spelling of Crenicara, to Crenacara. The whole tendency in nomenclature at present is to let a name stand as it is written. Purism breeds confu ion.

Dr. Rudolph von Ihering in the same journal describes four mailed catfishes from Brazil, additional to those contained in the monograph of Mr. Regan.

In the *Revue Su'sse*, (vol. 13, 1905), Mr. Regan describes six new species of fishes in the museum of Geneva. One of these, *Sciæna* (*Bairdiella*) *bedoti* is from Cuba.

In the *Proceedings of the Bombay Natural History Society*, Mr. Regan describes a number of new species from the Persian Gulf with a series of excellent figures.

In the *Comptes Rendus of the Sixth International Congress*, 1904, Dr. Jacques Pellegrin records a small coll ction of fishes from Lake Tchad, the first made in these waters. Its fauna is, however, not distinct from that of the great rivers of Central Africa. Dr. Pellegrin also describes the hatching of the eggs of the perch-like fish, *Tilapia galilæa*, in the mouth of the mother.

In the *Report of the Commissioner of Fisheries for 1904*, Ulysses O. Cox gives a revision of the cave fishes, Amblyopsidæ, of North America, with figures of most of the species. At about the same time, Dr. C. H. Eigenmann describes two new species of cave fishes, (*Biol. Bull. Ind. Univ.*, vol. 8, 1905). These are *Typhlichthys wyandotte*, from Corydon, Indiana, and *T. osborni* from Horse Cave, Kentucky.

In the *Proceedings of the Washington Academy of Science*, Dr. C. H. Eigenmann and David P. Ward give an excellent monographic review of the South American fishes constituting the family of Gymnotidæ. A few new generic names are proposed.

Dr. Robert von Lendenfeld (*Bull. Mus. Comp. Zoöl.*, 1905) describes in detail the radiating organs of deep-sea fishes, with a series of admirable plates. These organs, known as luminous organs or glands, are for the purpose of radiation of waves of light, ultra red, perhaps, or in some cases of electricity.

In the *Report on Norwegian Fishery Investigations*, Dr. Robert Collett describes the species taken in the cruise of the *Michael Sars* in the North Sea. Valuable notes accompany the list of species. A new subgenus, Bathyalopex, is proposed for *Chimæra mirabilis* and for the Japanese species, *Chimæra mitsukurii*, in which the anal is not notched.

In anothe paper, Collett describes a new lantern-fish, *Lampadena chavesi*, from the Azores.

In two volumes, large quarto, under the title of *A Guide to the Study of Fishes*, Henry Holt and Co. publish a general account of fish life, fish structure, and fish classification by Dr. D. S. Jordan. This work is doubtless the most elaborate yet published on this topic. It is beautifully printed and fully illustrated, and the author has tried to put into it all that he knows about fishes which can have an interest to naturalists and to the cultivated public generally. Works of similar scope but less detailed in their treatment, are Dr. Günther's *Introduction to the Study of Fishes* and the volume on fishes in the Cambridge Natural History, this last work appearing almost simultaneously with Jordan's *Guide*.

Dr. C. R. Eastman (*Mém. Soc. Géol. de France*, vol. 13, 1905) treats exhaustively of the Eocene fishes of Monte Bolca in the Museum d' Histoire Naturelle de Paris. A number of new species are described and figured. Not much account is taken of the questions of priority, else the preoccupied name, Platyrhina, would not be used for Discobatus of Garman, or Trygon for Dasyatis. Zanclus hardly belongs to or even near to the Carangidæ, and Serranus, Apogon, and Dentex are not nowadays Percidæ. But these are minor issues, in comparison with the elucidation of this earliest of fossil tropical fish faunas having a modern cast.

In the *Report* of the State Geologist of New Jersey for 1904, Dr. Charles R. Eastman contributes a popular account of the significance of fossil remains of fishes. This is followed by a description of species found in the Triassic rocks of New Jersey, with photographic plates of numerous species.

In the *American Geologist*, vol. 24, 1904, Dr. Bashford Dean shows that the Permian fish, Menaspis, may be a Chimæroid.

Mr. L. Hussakof (*Bull. Amer. Mus. Nat. Hist.*, 1905), discusses the fish called *Dinichthys intermedius*, and its probable traits in life.

An interesting and valuable biographical sketch of Peter Artedi, the "father of ichthyology," is published by Einar Lönnberg, as a

memoir in behalf of the Swedish Academy of Science. "Artedi was the first to settle definitely the notion of genus in zoology and to make clear the difference existing between species and variety, to demand a classification on natural principles into classes, orders, etc., based inter alia on comparative anatomical investigation." This address marks the bicentennary of the birth of Artedi, March 10, 1705.

The seventh volume of the *Cambridge Natural History* treating of the "Fishes, Ascidians, etc.," is a most substantial and valuable contribution to our general knowledge of these groups. In this book of 753 pages, the Hemichordata, are treated by Dr. S. F. Harmer, the Ascidians and Lancelets by W. A. Herdman, the lower fishes by Dr. T. W. Bridge, and the Teleosts by Dr. G. A. Boulenger. The excellent account of the structure and physiology of fishes is by Dr. Bridge. Throughout the volume, the treatment of the subject is accurate and dignified, though distinctly technical. The fossil forms, represented by excellent plates, are placed in proper sequence with the living forms. Modern researches in the osteology of fishes have been carefully considered, and in general, more attention has been given to the rules of scientific nomenclature, than in most general treatises on ichthyology. A series of small maps showing the geographical distribution of various groups is an excellent feature of the work. By placing the Cycliæ, Ostracodermi, and Arthrodira in the appendix, Dr. Bridge is enabled to avoid any theory as to the actual relationship of each. The Cladoselachidæ are regarded as the most primitive of the known sharks, and the Crossopterygians as probable ancestors of amphibians, Dipneustans, and the bony fishes, in accordance with the carefully considered theory of Dr. Dollo.

The treatment of the Teleostei by Dr. Boulenger represents long-continued studies on the part of an original and forceful worker. In the main, the general views and the sequence adopted coincide fairly with the classification current among American ichthyologists. This is gratifying, as tradition at the British Museum leads along the old Cuvierian lines. The adoption of the theory of development does away with the sequence which would place the perch as a typical fish at the head of the series. The head of the series of bony fishes must be the most primitive of these forms, and this, all now agree, must be found in the herring-salmon group, called by Cope, Isospondyli.

From these generalized forms, we proceed to those more and more complex. In this, there is no longer much doubt as to the main facts, but there is room for great play of individual whim or taste in the relative sequence of the branches. As a book classification must be

linear, the sequence can be natural in only a very slight degree at the best. Dr. Boulenger prefers a less minute subdivision of families than that adopted by Gill, Cope, and American writers generally. This matter is not a vital one. There is something to be said on either side. In a subdivision too minute the close relation of forms may be lost sight of. On the other hand, by attaching aberrant forms to the nearest family, we often destroy the naturalness of our groups. As the suborders of Teleostean fishes are very unequal in value, very much intertangled, and for the most part incapable of trenchant definition, Dr. Boulenger has been no more and no less successful than others in defining them. The fault lies with Nature, who has not done her part in the elimination of interlocking forms. The emphasis laid on the characters of the Ostariophysi is a step forward, as is also the separation of the Symbranchii from the eels. There seems to be no very good reason for using the term Malacopterygii for the group defined as Isospondyli, as the great majority of the species called Malacopterygii by Cuvier belong to the Ostariophysi and Haplomi. The Haplomi of Boulenger is not a natural group, and more extended study is necessary before we can draw the line accurately between Isospondyli and Haplomi. The suborder Heteromi of Boulenger seems to be unduly extended. The Catosteomi (Lampris and sticklebacks) form an unnatural association, as Dr. Boulenger (p. 627) seems about ready to admit. It appears, however, reasonable to place the pipe-fishes in the same suborder with the sticklebacks. The Percesoces of Boulenger can hardly hold together long. Ammodytes is a jugular fish, the Scombresoces diverge in the direction of the Haplomi, while Polynemus, Chiasmodon, Stromateus, and Anabas, all diverge widely from the mullets and other typical Percesoces, and each in its own way. As a matter of fact, the Percesoces at the best are no farther from the true Acanthopterygii than is Beryx or Gobiesox or Callionymus. Percopsis, placed by Boulenger with the Haplomi, is better separated from everything else, than the members of the Haplomi-Catosteomi-Percesoces-Acanthopterygian series are from each other. But this is the fault of Nature, not of the systematists. Aphredoderus, as Starks has shown, is not a Berycoid fish. The group Zeorhombi (the John Dory and the flounders), indicates an association not yet proved, but on the whole the allocation of families and genera among the perciform types is very satisfactory. The "new University" of Cambridge, to borrow the phrase from the preface to the work, is to be sincerely congratulated on this additional contribution to sound science and scientific method. D. S. J.

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